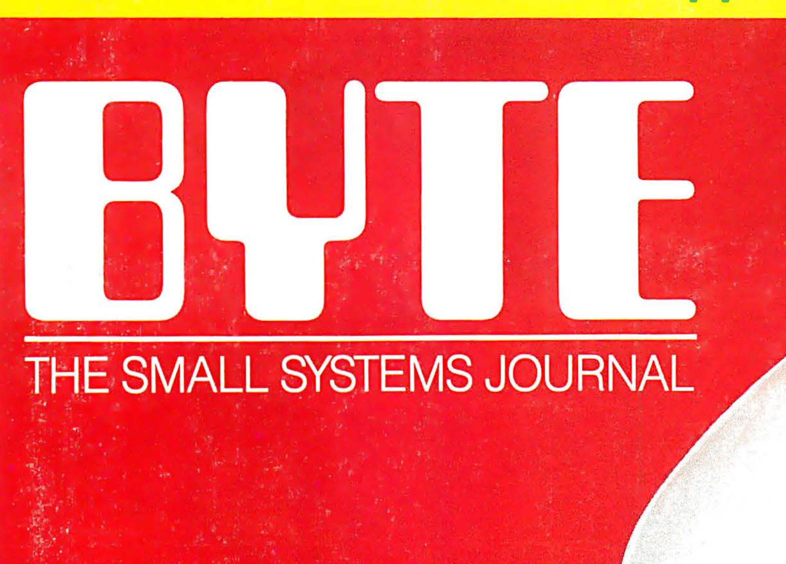
BONUS: BYTE Guide to Apple PCs



DECEMBER 1984 VOL. 9, NO. 13

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COMMUNICATIONS





Why every kid should ha

Today, there are more Apples in schools than any other computer.

Unfortunately, there are still more kids in schools than Apples.

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Which is why it makes good sense to buy them an Apple® IIc Personal Computer of their very own.

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Even the price of the IIc is small — under $1100.*

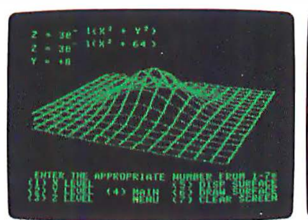
Of course, since the IIc is the legitimate offspring of the IIe, it can access the world's largest library of educational software. Everything from Stickybear Shapes™ for preschoolers to SAT test preparation programs for college hopefuls.

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Not to mention fun programs for the whole family. Like "Genetic Mapping" and






With a IIc, your kid can do something constructive after school. Like learn to write stories. Or learn to fly. Or even learn something slightly more advanced. Like multivariable calculus.

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"Enzyme Kinetics."

And the Apple IIc comes complete with everything you need to start computing in one box.

Including a free 4-diskette course to teach you how—when your kids get tired of your questions.

An RF modulator that can turn almost any TV into a monitor.

As well as a long list of built-in features that would add about $800 to the cost of a smaller-minded computer.

128K of internal memory—twice the power of the average office computer.

A built-in disk drive that would drive up the price of a less-senior machine.

And built-in electronics for adding accessories like a printer, a modem, an AppleMouse or an extra disk drive when the time comes.

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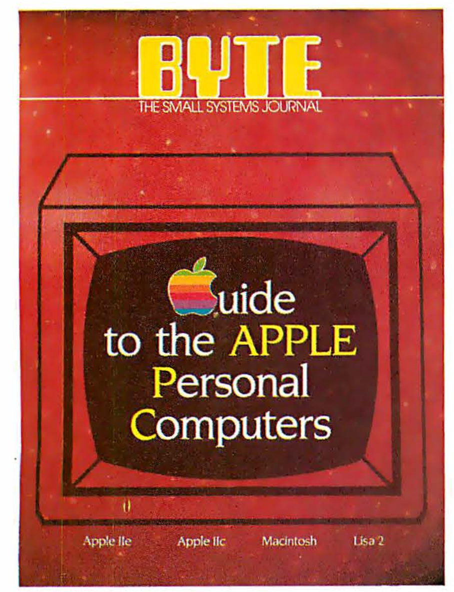


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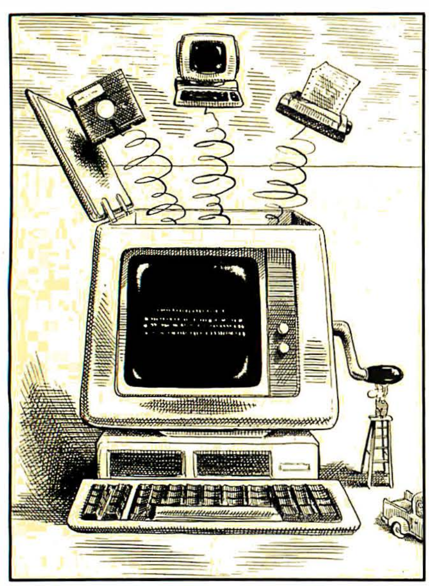
To learn more about it, visit any authorized Apple dealer. Or talk to your own computer experts.

As soon as they get home from school.

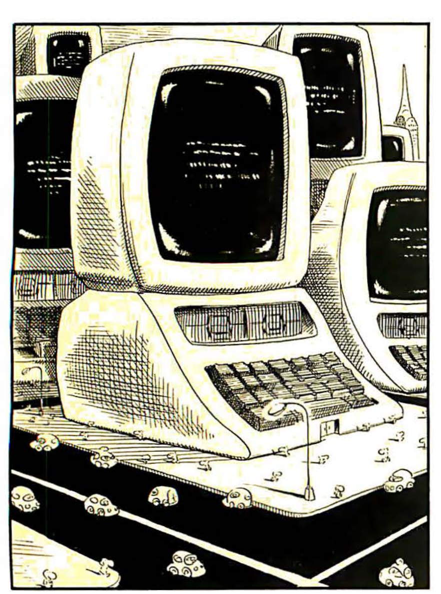
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The BYTE Guide to the Apple Personal Computers, a special section, begins immediately after the Reader Service page.



96



128

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FEATURES

THEME: COMMUNICATIONS

REVIEWS

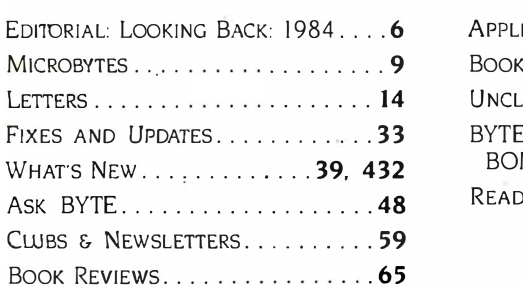
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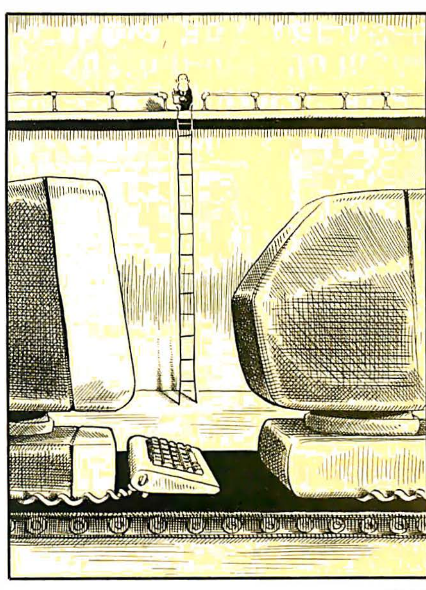
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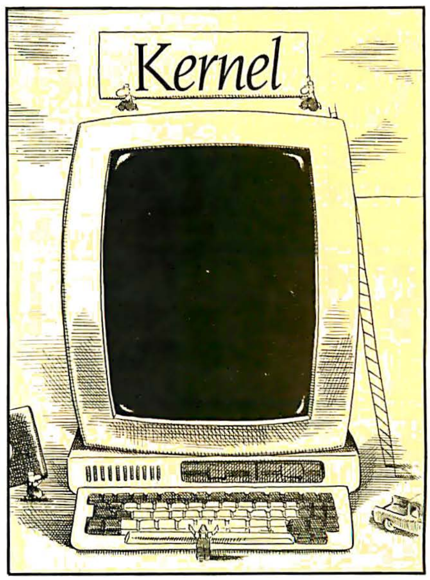
BYTE December

VOLUME 9, NUMBER 13, 1984

KERNEL




234



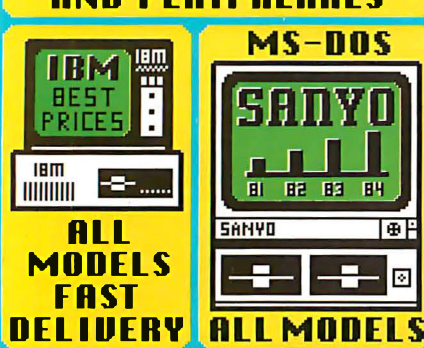
305

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Looking Back: 1984



To hear some people tell it, the world of personal computing slowed down this year. The best way to correct that impression is to list a few of the more significant developments covered in BYTE in 1984.

Computers: There was an abundance of impressive new machines: the Macintosh; the IBM PCjr and PC AT; the Hewlett-Packard 150 and Portable; the Tandy 2000, 1200, and 1000; the Mindset; the Data General/One; the Apple IIc; the AT&T PC; the Compaq Deskpro; the Stride Micro 400 series; the TeleVideo Personal Mini and Color PC; the CompuPro 10; the Corona Mega PC; the Tektronix 4404 Artificial Intelligence System; the ITT Xtra; the NEC APC III; Seiko's wristwatch computer; and lots of 68000-based supermicros and IBM PC clones based on the 8088 or 80186 microprocessor.

Software: Versions of UNIX and Pick for personal computers blossomed. ProDOS conquered the Apple II world. MS-DOS 3.0 arrived, and all or some of Concurrent CP/M, Concurrent DOS, and Concurrent PC-DOS may have arrived. Among languages, there were several new BASICs and Cs, Gold Hill's GCLISP, micro-PROLOG, various versions of Modula-2, and one of the biggest bargains in the history of personal computing, Borland's Turbo Pascal. Artificial-intelligence products gained a foothold on personal computers: Teknowledge's M.1, General Research's TIMM expert system, Expert-Ease, and Level 5 Research's Insight Knowledge System (a mere $95, and it looks quite interesting).

Environments for applications software sprang up all over the place, including IBM's own TopView and Digital Research's GEM. Thinking aids such as ThinkTank and MaxThink showed that they are of real value to personal computer users. There were friendly databases such as Infoscope, Please, 4-1-1, and Fast Facts. The long-awaited dBASE III came out, as did a major competitor, R:base 4000, and query systems such as CLOUT and In-Search. There were integrated software packages such as Symphony, Framework, and DayFlo.

Tom Jennings's Fido bulletin board and FidoNet communications system did a lot of good for a lot of people.

Assorted Hardware: Perhaps the story with the greatest impact was the decline in the price of 1200-bps modems, which gave telecommunications a boost. CMOS spread far and wide, making many machines small and cool. LCDs moved up to 25 lines by 80 columns, RAMs jumped to 256K bits, microprocessors stepped up to 32 bits, and mice became commonplace. A host of special graphics chips reached the market.

Developments in mass storage included inexpensive optical storage devices, such as the first personal computer products based on compact audio disks, high-capacity mini hard disks, abundant microfloppies, 10-megabyte floppies, and bubble-memory cards and peripherals. In printer technology, we saw advances in dot-matrix, thermal-transfer, ink-jet, and laser printers. The HP LaserJet and its Canon mechanism brought the price of laser-printer technology down to $3500. TI's natural-language interface, NaturalLink, gave hints of things to come.

Steve Ciarcia, as usual, was a one-man industry. He gave us the schematics and explained the technology for a smart terminal, a Z8000 system that resides in an IBM PC, a scrolling alphanumeric LED display, a phonetic speech synthesizer, a musical telephone bell, an AC power monitor, an AC power controller, a sonar range finder, and a speech-recognition system.

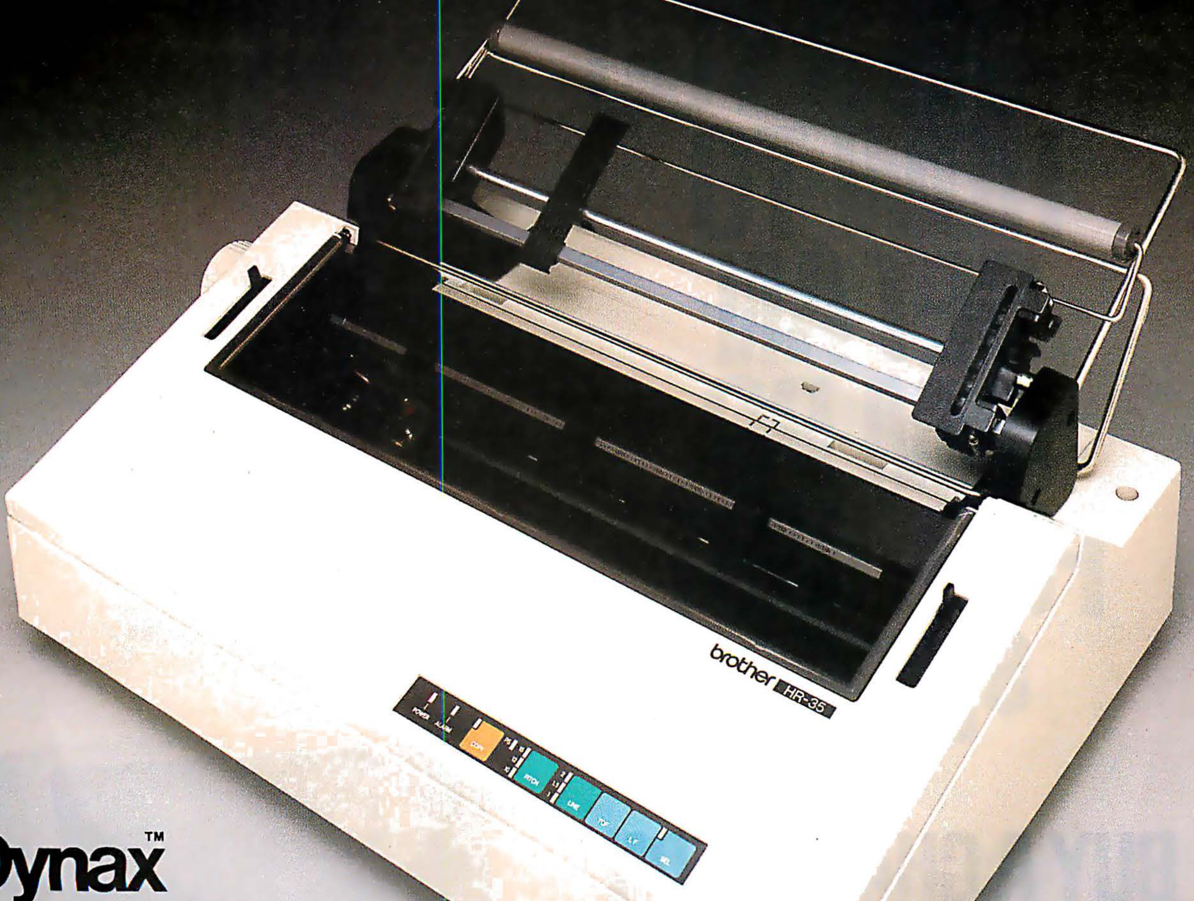
The shakeout saddens us all. Some talented people are temporarily out of work, and some impressive new products have failed in the marketplace. But the personal computing industry makes relentless progress despite the varied fortunes of its constituents. It is no longer a rumor that Commodore will market the impressive 68000-based machine developed by Amiga. By this issue's cover date, the rumor that Atari will market the Mindset may have been confirmed. These two developments could bring impressive and powerful hardware to millions at low cost.

Be of good cheer.

—Phil Lemmons, Editor in Chief

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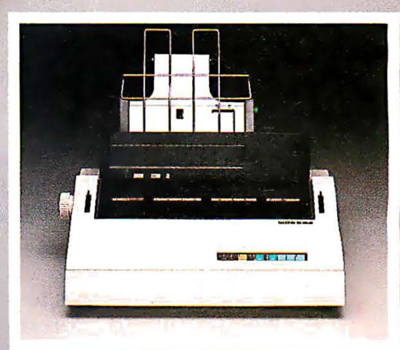
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Staff-written highlights of late developments in the microcomputer industry.

Sanyo's Graphics Card for 550, Portable Color Computer

Sanyo, Moonachie, NJ, announced a $199 graphics card for its MBC-550 computer, enabling it to run programs that directly address IBM PC graphics screens, including the Lotus 1-2-3 spreadsheet. Bundled with the card are GW-BASIC and MS-DOS 2.1.

The company also announced an IBM-compatible portable computer with a built-in color display. The MBC-775 includes two 360K-byte 5¼-inch disk drives, two full-length IBM-compatible expansion slots, a parallel printer port, and RGB and composite video outputs. It should be available in January for $2599.

Integrated Program Has Slide-Show Feature

Xanaro Technologies Inc., Toronto, Ontario, has unveiled Ability, a $495 integrated software program featuring a spreadsheet, word processing, a free-form database, graphics, and communications functions. Also included is Presentation!, which combines words, graphs, numbers, and music in a slide-show format. The program's user interface avoids use of MS-DOS commands, using a menu format instead. Text, spreadsheet, and graphics data can be intermixed on the screen.

Microsoft Delays Windows to Mid-1985

Microsoft announced in October that its Windows multitasking graphics operating environment would be delayed until at least June 1985. Windows was originally announced in November 1983 (see the December 1983 BYTE, page 48) and had been scheduled for release last month to manufacturers, who were to customize it for their machines.

Since Windows was announced, both IBM and Digital Research have introduced multitasking, windowing graphics environments. IBM announced TopView, which was released to software developers in September and is scheduled for general release in early 1985 with a price tag of $149. In October, Digital Research began shipping its $295 Concurrent PC-DOS (earlier called Concurrent CP/M-86 version 3.1 with PC-DOS emulation), which runs several MS-DOS programs simultaneously. Also in October, Digital Research announced its Macintosh-like Graphics Environment Manager for the IBM PC (see page 39), also planned for early 1985 release.

New Laser and Ink-jet Printers

Concept Technologies, Portland, OR, now offers the Concept Laser 8, a version of Canon's LBP-CX 8-page-per-minute laser printer. The $7995 printer supports both Virtual Device Interface and Tektronix 4014 graphics input, as well as direct bit-mapped images or text information. Dataproducts, Woodland Hills, CA, unveiled a $12,900 24-page-per-minute laser printer based on a Toshiba printer. The firm also announced seven new daisy-wheel and dot-matrix printers. Diconix, Dayton, OH, introduced the Dijit 1, an 18-page-per-minute ink-jet printer with a resolution of 300 by 300 dots per inch. The printer is available to other manufacturers for $5000 to $7500.

Computer Crime Bill Passes

A federal computer crime bill was included in the continuing resolution signed into law in October. Those who access classified information using a computer could be convicted of an additional felony. Other offenses are misdemeanors, including unauthorized access of a federal government computer or of data protected by the Fair Credit Reporting or Financial Privacy acts. Penalties include up to one year in prison and fines of up to $5000 or twice the value obtained or loss created by the offense.

(continued)

Compact Disc Used for Data Storage

North American Philips Corporation has sold compact disc-mastering equipment to 3M, which will manufacture discs for use as data storage for computers. NAPC's Philips Subsystems and Peripherals Inc. division also announced that it will offer its CM 100 Compact Disc Read-Only-Memory (CD ROM) unit to other manufacturers. The CD ROM is similar to existing compact disc players from Philips, but it has enhanced error-checking and -correction features. Philips would not detail pricing but said OEMs would pay less than $1000 for the complete drives; 3M said the 550-megabyte compact discs could be manufactured for less than $10 each.

Datacopy Unveils $4000 OCR/Digitizing System

Datacopy, Mountain View, CA, announced a $4000 version of its Word Image Processing System. The Model 700 includes a flatbed scanner and software; previous versions, priced from $9000, used a different type of scanner. The system can digitize images as well as recognize characters printed in 10-point Courier or 12-point Prestige Elite type; other fonts are planned.

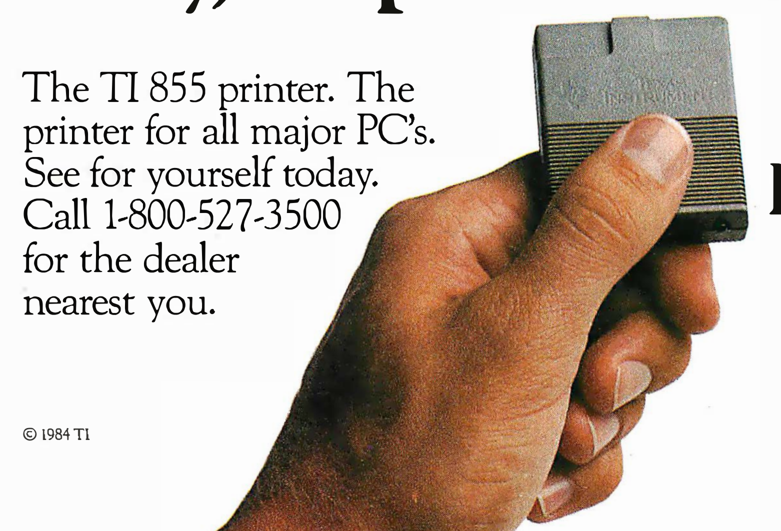
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Kodak announced a line of "Instagraphic" products to create color slides of computer screens; the products will directly compete with Polaroid's Palette system. . . . **Brown Disc** announced a new lighter-weight, lower-cost plastic rigid disk to replace the aluminum medium now used in 5¼-inch hard-disk drives. . . . **Verbex**, Bedford, MA, announced the Series 4000 Voice Recognizer, a continuous speech-recognition system priced at $4900. Matching Voice Planner software for MS-DOS computers costs $500. Each person uses a different CMOS memory voice cartridge, which is plugged into the Voice Recognizer unit. . . . **Texas Instruments** introduced Explorer, a LISP-based artificial-intelligence workstation priced from $52,500. . . . **IBM** introduced a Chinese-language version of its 5550 Japanese personal computer; it will also sell the IBM PC and PC XT in China. . . . **Datapoint** announced products that would link IBM PCs to its ARC local-area network. . . . **Zilog** has added ROM-less versions of its low-power Z8 microprocessors. . . . **Videotex Systems Inc.**, Dallas, TX, now offers a complete videotex system, including a 512K-byte IBM PC, 10 terminals, two modems, and software, for $8000. . . . **Matsushita**, one of Japan's largest manufacturers, has licensed **Drexler's** LaserCard. The LaserCard stores 2 megabytes of information on a credit-card-size optical strip. Drexler is also developing a 20-megabyte version. . . . **Zenith Data Systems** sold $99.8 million worth of its Tempest-version Z-150 microcomputer to the Defense Department. The computers are shielded to prevent electronic eavesdroppers from decoding RF signals emitted by the machines. . . . **Mindset** announced the Mindset Video Production System, a version of its personal computer designed to mix computer graphics and standard video signals from VCRs, laserdiscs, cameras, or televisions. The system will cost $3799. . . . **Seagate** announced new hard-disk drives at COMDEX, including a 10-megabyte 3½-inch drive, a 20-megabyte half-height 5¼-inch drive, and 20-, 30-, and 40-megabyte full-height drives with an average access time of 40 milliseconds. . . . **Extended Systems**, Boise, ID, announced LaserRight, which allows three computers to share a single Hewlett-Packard LaserJet printer. The printer and a 128K-byte buffer are included for $4495. . . . **Tandberg Data** now offers a $1000 quarter-inch streaming-tape drive for the IBM PC. . . . **General DataComm**, Middlebury, CT, announced a $699 1200-bps modem that it says has a lower error rate than other 1200-bps modems. . . . **Entrepo Inc.** (formerly Exetron), Sunnyvale, CA, said it had solved reliability problems that had plagued the company's wafer-tape drives for several years and that it is ready to ship an $85 retail version of its Quick Cassette storage system for Commodore computers. . . . **Hayes** announced a 2400-bps modem, priced at $899. The modem also supports 1200-, 600-, and 300-bps communications. . . . **IBM** is reportedly talking to Toshiba and other Japanese companies about purchasing a large quantity of 3½-inch disk drives.

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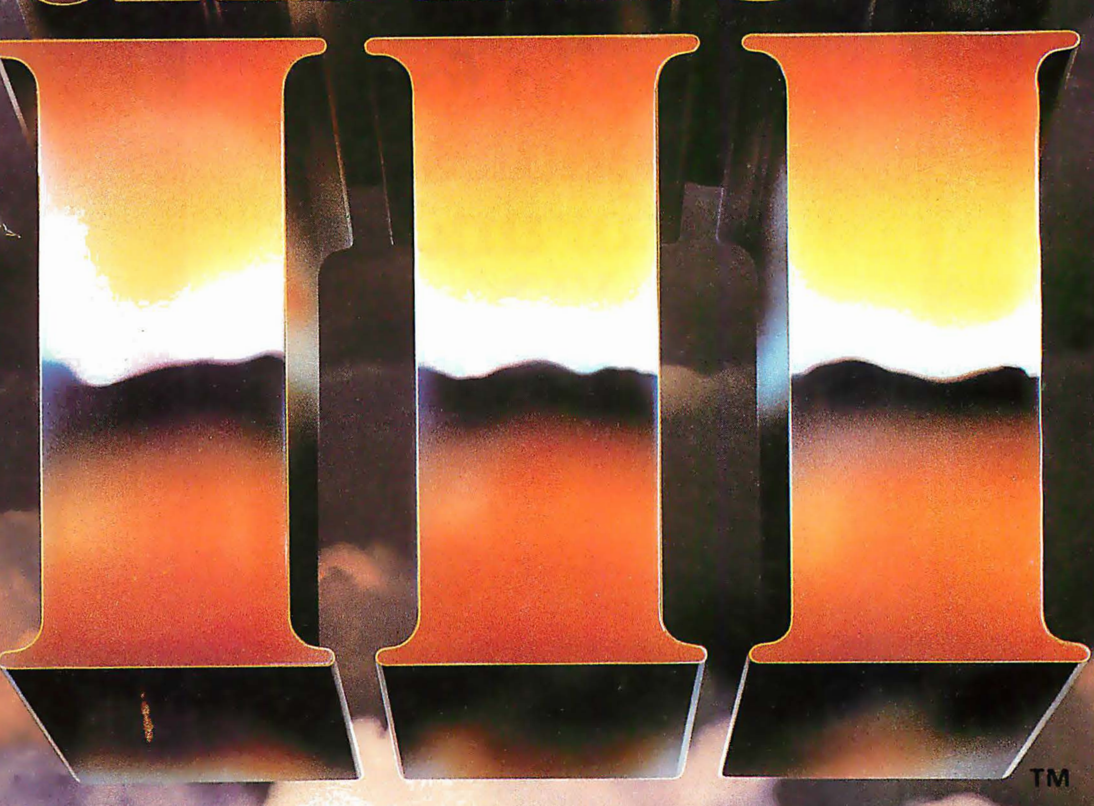
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CHOOSING A LANGUAGE FOR STUDENTS

I am writing in regard to Fred A. Masterson's article "Languages for Students" (June, page 233). Has COMAL (Common Algorithmic Language) not yet surfaced in the United States? Here in Europe this language is the subject of growing interest among educators. It is the favored language for use in schools in Denmark, Sweden, Norway, and Ireland, and it is gathering momentum in many other countries. COMAL combines the ease of use of BASIC with the control structures of a Pascal-type language. It was first developed by a Danish educator, Borge Christensen, in the mid-1970s as a respectable "front end" to a very poor BASIC. Sophisticated COMAL interpreters are now available on a wide range of microcomputers as well as minicomputers and mainframes. The portability of the language is maintained through an international COMAL Standardization Committee, which meets at least twice a year.

What is so special about COMAL? Let's look at Mr. Masterson's four language requirements:

- *Simplicity*: COMAL's simple and coherent user interface, with interactive error messages and structure checking, retains the best features of BASIC. "Spaghetti" code is eliminated through the consistent use of block-structured statements. Not only is COMAL simply to learn, it is also easy to progress from it to other high-level languages—the beginner already has a grasp of *structure*, which BASIC often ignores or, in many cases, inhibits.
- *Power*: COMAL is a powerful language, providing the user with named procedures, parameter passing by value or reference, local and global variables, and a range of built-in functions. This allows for modular development, use of recursion, and other powerful techniques in software development. On the other hand, COMAL is a procedural language with limited data types and structures (int, real, string, and arrays). It is not intended to compete with functional languages such as LISP. COMAL's use of closed procedures allows it to be easily customized to the needs of a particular application. Complex routines can be encapsulated in closed procedures in a way that is impossible in BASIC. These routines can then be invoked by name without any danger of ambiguity in the use of variable names. This allows the COMAL language to be effectively extended *by the user* for CAI, business, technical, and other applications.
- *Compatibility*: From its vantage point astride the pillars of BASIC and Pascal, COMAL prepares the novice well for a variety of future computer experiences. Its interactive nature provides a prelude for the user interfaces of most modern commercial packages; its structured flow of control prepares the student for learning more advanced languages such as C, Pascal, or Ada. In a more specific sense, the source-code compatibility that COMAL allows between a growing number of microcomputers, minicomputers, and mainframes is far in advance of most other languages.
- *Cognitive richness*: Mr. Masterson reserves this term to describe languages that process entire data structures such as arrays and lists. Such languages are indeed a "delightful surprise" to students who are used to "one thing at a time" languages. By the same token, COMAL comes as a delightful surprise to educators who have sought in vain for a language that displays the simplicity and elegance on which cognitive richness is actually based.

In a nutshell, COMAL is the answer to Mr. Masterson's final plea for "responsive, customizable languages for CAI and personal computing." If you would like more information on this "new" (i.e., 10-year-old) language and its various implementations, contact me at the Department of Computer Science, Engineering School, Trinity College, 201 Pearse St., Dublin 2, Ireland.

RODY RYAN
Dublin, Ireland

I read with interest Fred Masterson's fine article "Languages for Students." Certainly his selection criteria for a computer language for educational use hit the mark in many ways. He is exactly right in his comments concerning the cumbersome and slow cycle of prepare-source-file/compile-source-file/link-object-file/run, which effectively prevents experimentation, exploration, and efficient learning.

It should be noted that program developers are also students: they are students of the problem they are trying to solve, and they too greatly benefit by the quick cycle of development offered by truly interactive languages like Logo and FORTH, in which on-the-spot compilation is synergistically combined with extensibility, so that new commands can be created, tested, instantly modified and improved, and then combined with earlier commands to build larger and larger modules and, ultimately, the final program.

In defining any set of criteria, however, we all are apt to overlook those with which we have no experience. For example, the only programmers who demand extensibility in a programming language are those who have worked with an extensible language. Those who lack that experience seem to be unable to grasp the power of extensibility and how much it can help a programmer.

Similarly, Mr. Masterson fails to specify what seems to me to be an essential characteristic for a programming language for students: transparency. A programming language is transparent if its implementation mechanisms are clear to the student, so that she or he can look at the internal representation of the source code and understand how it came to be and how it works. Just as the transparent plastic models of four-cycle engines can help mechanically inclined students better grasp the theory and practice of engines, so a clear and easily understood program-

(continued)

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ming-language implementation can increase both the confidence and understanding of the students.

Unfortunately, most programming languages are implemented as "black boxes"—source code goes in, and some sort of machine instructions come out. Not only are the workings of the compiler a mystery, but often its product as well. Even in theory, students cannot work back from the object code to derive the source code that they provided.

FORTH, on the other hand, has a simple and effective compiler that actually resides within the language—the compiler consists of FORTH commands, and they can be extended and modified just like any other FORTH commands. In addition, the product of the FORTH compiler, the indirect threaded code, is easily grasped by students so that they can look at a representation of memory and understand what is there, how it works, and even how it came to be—how the compiler works.

As for the data structures that Mr. Masterson feels are essential, it is certainly important that students be able to manipulate these structures easily. But the students will learn the characteristics and strengths of the various data structures much better if they themselves construct the commands to create and manipulate the structures. Of course, that requires that the language be extensible. Again, the idea is to avoid handing students a completed "black box" and having them simply learn the rote manipulations. Students want understanding, which requires participation.

FORTH fits the criteria that Mr. Masterson specifies, as well as bringing its own special strength in terms of the missing criterion of transparency. I find it strange that his article failed to miss this almost ideal educational programming language.

MICHAEL HAM
Santa Cruz, CA

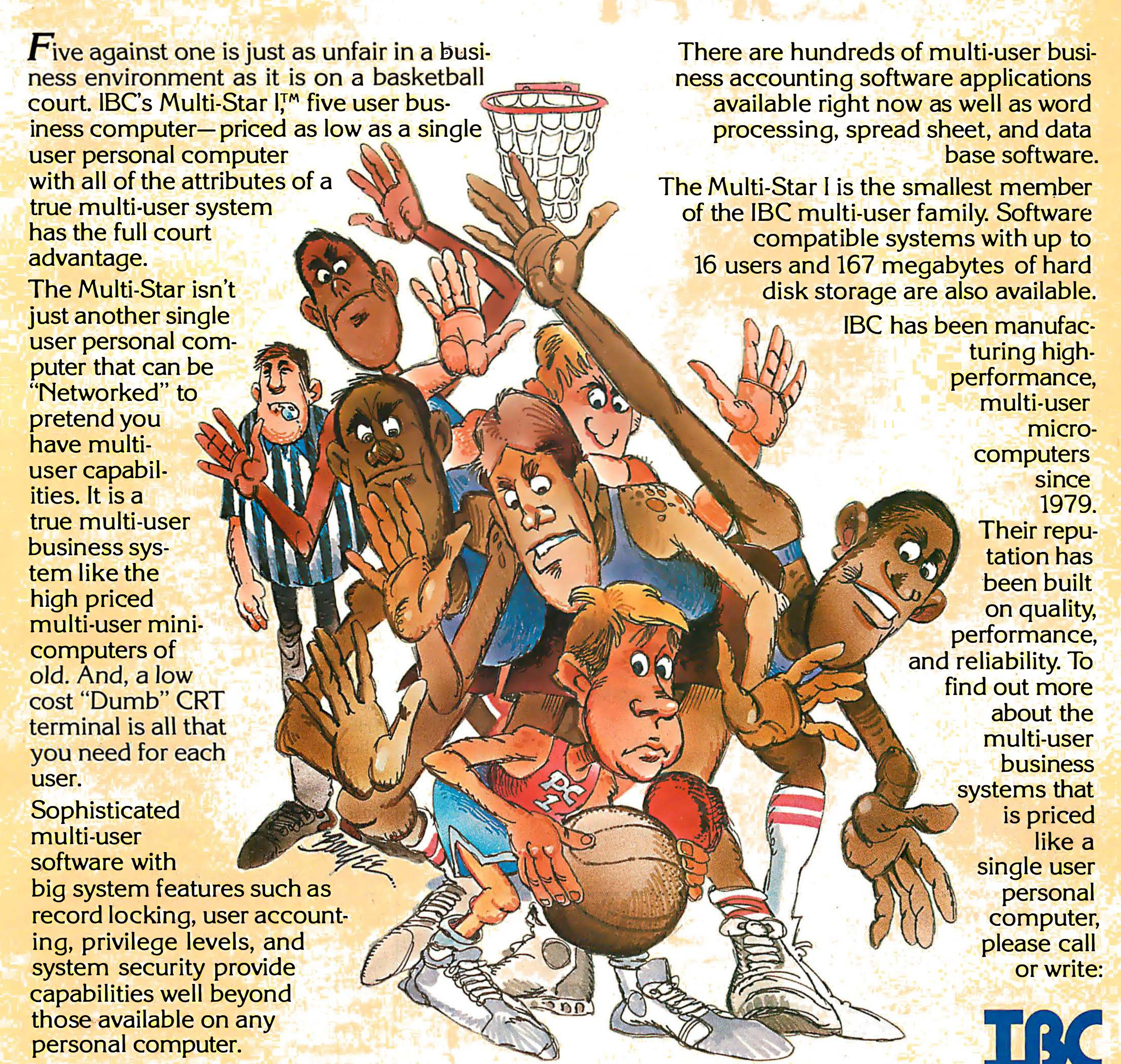
In his letter (July, page 16), Wendell Brown raised issues that are of concern not only to high school teachers. I am attempting to design a course about computers for law students and am seriously concerned about what—if any—programming language I should use. I suspect that the safest approach may be to introduce the students to a little bit of assembly language so that they can get an understanding of how computers actually work, with registers, stacks, program counters, etc., and then introduce them to some applications programs. The major portion of

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such a course, with its specialized student body, could then be concerned with larger issues that are neither machine- nor language-dependent.

But if I take that approach I foresee a large problem because many students will already have had diverse experiences in programming. I am particularly worried about how to deal with students who are experts at writing "spaghetti" code in some version of BASIC. Perhaps the solution lies in introducing them to some language such as Prolog, in which the idea of a GOTO statement doesn't make any sense. In elementary and high schools the same result might be accomplished (although I am not sure because I don't know the language) by using Logo, which is available on the ubiquitous Apple II.

The problem, however, does not arise necessarily or solely from the use of BASIC. The worst spaghetti code I ever wrote was on a TI-59 calculator. And it is possible to avoid spaghetti code even if one has to use GOTO statements, although it is admittedly difficult.

CBASIC, which Mr. Brown refers to, can be used to write orderly code. As I recall, the only time it is necessary to use a GOTO in that language is in the special case of GOTO on end of file. One can avoid GOTO statements in a series of IF...THEN statements by using GOSUB statements instead. In complicated cases the GOSUB may have to set a flag that the main routine checks with another IF... THEN statement in order to determine where to go next. The result may not be as clear to the reader as a segment of Pascal, but, on the other hand, it will not be a tangled web. I suspect that more can be taught about structured programming in BASIC than in Pascal; with the first language the student has to supply the structure, in the second the student cannot avoid it even if he or she wants to.

The problem is not only that high school students go on to take computer courses in college, but that they go on from college to law schools or theology schools or even, sometimes, the real world. Except for students who are going to become programmers or computer scientists, I should think that any introductory programming course may be a waste of time or worse. I believe that everyone should in some sense be computer-literate, but that does not mean that everyone should know how to write programs. Instead, everyone should know what computers can do—and what they can't. I really don't think that a programming course is the

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best way to learn that. In fact, I fear that there are a great many programmers who are not computer-literate. Neither BASIC nor Pascal is much help in understanding the *Entscheidungsproblem* or the Turing test, but certainly those are examples of issues that the computer-literate, as well as the computer-literiati, should be able to address.

PETER D. JUNGER
Professor of Law
Cleveland, OH

The letter from Wendell Brown was a complaint about using BASIC to teach programming in high school, and it ended with a plea for a well-structured, powerful, interpreted language for the Apple II. I am happy to direct Mr. Brown's attention to such a language.

The language is modular and incrementally compiled but it is interpreted so there is an "immediate mode" as in BASIC. It allows procedures and functions with local and global variables. Uninitialized variables are not permitted, but variables do not have to be predeclared. Names for variables and procedures can be made practically any length, resulting in self-documenting programs. The error messages are descriptive and extremely useful. It permits a wide variety of looping structures. Procedures are easily made recursive. Character strings are easily handled. For arithmetic, it has real numbers with six-digit accuracy and it also has integer arithmetic operations. Trigonometric functions, but not logarithms, are built in. Graphics include turtle graphics, coordinate graphics, color, and full control of the text screen.

As in C, the user can create a system of software utilities or a "shell" for other users. As in Pascal (but not UCSD Pascal), procedures can be passed as parameters. Combined with descriptive variable names, this feature allows for "natural language" programming. Data typing is convenient, though not as strict as Pascal; for example, one cannot take the square root of "false" as one can easily do in BASIC, but on the other hand, real numbers can easily be manipulated as character strings.

This language is widely available for the Apple, Commodore 64, Atari, and the IBM PC. It was developed rather carefully as a teaching language (as were BASIC and Pascal) and has been thoroughly tested.

The language is Logo.

Logo has a well-deserved reputation as a language that is easy for young children to work with. For this reason it has largely been overlooked at the high school level. Most people are surprised to learn that it's more than a graphics package. In fact, it is so far superior to BASIC that, in my opinion, there is no longer any rationale for teaching BASIC. For example, the whole problem of "structured programming" ceases to be an issue when you teach Logo; you write separate procedures, not programs. A long-time BASIC programmer has a hard time understanding the concept that a computer can have separate procedures in memory at the same time, accustomed as he or she is to the restricted nature of BASIC.

I taught BASIC for two years; in our school programming is a required part of the ninth-grade math class. We switched to Logo this year and it was like removing a blindfold and ankle chains. Everything is easier. I took my old list of programming projects from BASIC and added more to it. Is programming power an issue? The Commodore Logo that I use has an assembler and a sprite editor, both written in Logo. Logo is a dialect of LISP, which is the language used on the cutting edge of artificial-intelligence work. Is speed an issue? Logo is slow, as befits an interpreted language, and there is no compiler avail-

Table 1: *A comparison of pointer versus subroutine threading.*

Pointer-threaded	Subroutine-threaded
(2 bytes in list)	CALL nnnn (3 bytes)
POP reg	MOV reg,[DI]
LODSW	INC DI
XCHG DI,AX	INC DI
JMP WORD-PTR [DI]	RET
39 clock cycles	38 clock cycles

Listing 1: *Some pointer-threaded coding examples for the 68000.*

```
  Register usage:
        A7      Interpreter Pointer
        A6      Return Stack Pointer
        A5      Data Stack Pointer

  A primitive looks like this:
- "Name"                    Character count plus ASCII name
- Link Address              Long word
                            <- Jump-up address

-
-       (Machine code body)
-
- RTS                       Return from subroutine

  A secondary:
- "Name"                    Character count plus ASCII name
- Link Address              Long word
                            <- Jump-up address
- MOVE.L      A7,-(A6)      Push interpreter pointer on return stack (2 bytes)
- LEA         8(PC),A7      Point IP to second address in threaded list (4 bytes)
- JMP                       Jump to first address in threaded list (2 bytes op code)
- ADR1
- ADR2                      (Every address 4 bytes)
- ADR3
-
-
- ADR SEMI

  The primitive SEMI controls return to the calling secondary and consists of the code:

SEMI:   MOVEA.L   (A6)+,A7      ;Pop interpreter pointer
        RTS                     ;Continue execution at next higher level
```

able yet. On the other hand, its purpose is as a learning tool, and in this spirit we do not teach driver education on a Ferrari.

JOEL TELLER
Berkeley, CA

ON "FASTER FORTH"

"Faster FORTH" by Ronald L. Greene (June, page 127) is a misguided attempt at optimizing pieces of FORTH without regard to their interrelationships. The poor choice of examples further clouds the comparison.

The time differentials given for pointer-threaded versus subroutine-threaded implementations are misleading for several reasons. One of the least efficient methods available for pointer threading is compared to a simple call-threading scheme. The unavoidable loss in data-stack efficiency is not explained in the article. Also, colon nesting is shown in the least favorable circumstances imaginable. It is seldom used to define a word consisting of two short primitives. It is more typically used to define words of sufficient complexity that its overhead is negligible.

The idea of keeping more than the top element of the stack in the registers is useless. FORTH uses the stack for parameter passing between routines. Its depth cannot be limited to so few elements without seriously cramping the generality of user-written words and eliminating recursive use. Any word that changes the number of elements on the stack would require not only a PUSH or a POP, but a string of register moves as well. (HS/FORTH does keep the top element of the stack in a register. This improves efficiency without long-term register shuffling losses.)

Assuming that you do need a decent stack facility, table 1 shows a more reasonable comparison of pointer versus subroutine threading. The preponderant inefficiency is in passing through the inner interpreter rather than through in-line code, so I have limited the comparison to just the RETURN-NEXT-RUN code. Since parameters from the data stack will usually be required, I included a single POP operation. A second stack operation adds 8 to 10 clock cycles to the pointer-threaded example and 20 clock cycles to the subroutine-threaded one. Where are the savings for adding half again as many bytes to our definition lists?

JIM CALLAHAN
No address available

(continued)

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I just read Ronald Greene's excellent article on reduction of overhead in TILs (threaded interpretive languages).

The author compares pointer-threaded and subroutine-threaded TILs and admits that the pointer-threaded implementation is superior with regard to execution time. I believe that a well-designed pointer-threaded TIL will also produce the most time-efficient code. What is the business of a TIL's inner interpreter? It has to direct program flow from one executable primitive to the other. Usually this is done by using a central-processor register as interpreter pointer (IP). The IP points to the next entry in the list of pointers to primitive or secondary routines. After completion of one routine, the next address is read, the IP is incremented by 2 or 4 bytes (depending on the address size), and a JUMP is executed to continue execution at the new location.

If you look closely at this process, you will see that you will not need more than a RET instruction to do the job *if you use the central-processor hardware stack pointer as the interpreter pointer*. The processor will permanently execute returns and will be "eating" up its way along the threaded list. This works well as long as there are only primitives to execute, with the time overhead being the execution time of a single RET instruction. And this is also the most important point, since jumps from one secondary to the next are very rare compared to the jumps from primitive to primitive. Even the highest-level words of a FORTH program consist mostly of primitives like DUP or LOOP.

Secondary routines require some code to save the IP on a stack (which must be maintained by another central-processor register) and load it with the starting address of the new threaded list.

To do this efficiently you need a processor that supports multiple stacks. Listing 1 shows some coding examples for the 68000.

The memory overhead to save and set up the IP and to jump to the first address is 8 bytes, so this technique pays only if the secondaries are not too short. But the time savings are optimal, eliminating the need for the JSR (CALL) instruction and leaving only the RTS (RET) instruction.

Note that this code is completely standalone and does not need any special inner interpreter. One disadvantage is that you can't implement the macros proposed by Mr. Greene, but because there is so little overhead they're not as necessary.

Care must be taken if the processor uses the hardware stack pointer (which serves in our case as IP) to process interrupts, not to PUSH any information into the threaded code. In the case of the 68000 this should not be a problem since it will use the supervisor stack pointer.

ALEXANDER BURGER
Sapporo, Japan

I cannot believe that Ronald Greene intends to imply that DUP DUP accomplishes the same thing as 2DUP. Fortunately, this apparent error does not detract from the sense of his argument, only from its credibility. Substitution of OVER OVER for DUP DUP avoids the distraction of a common slip that most beginners (like me) are painfully aware of.

DONALD GARWOOD
Mendocino, CA

(continued)

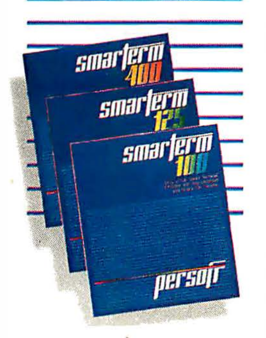
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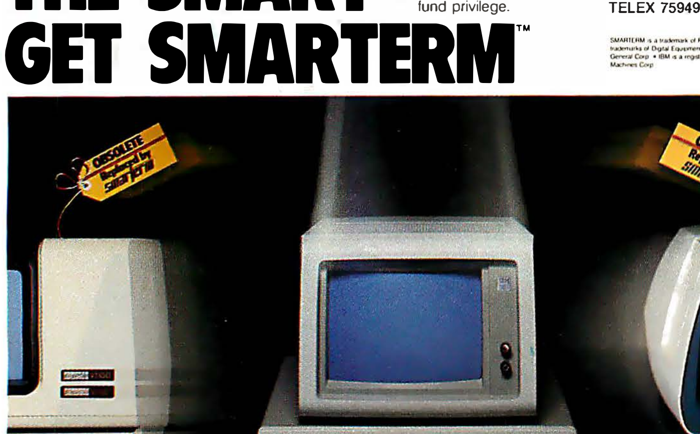


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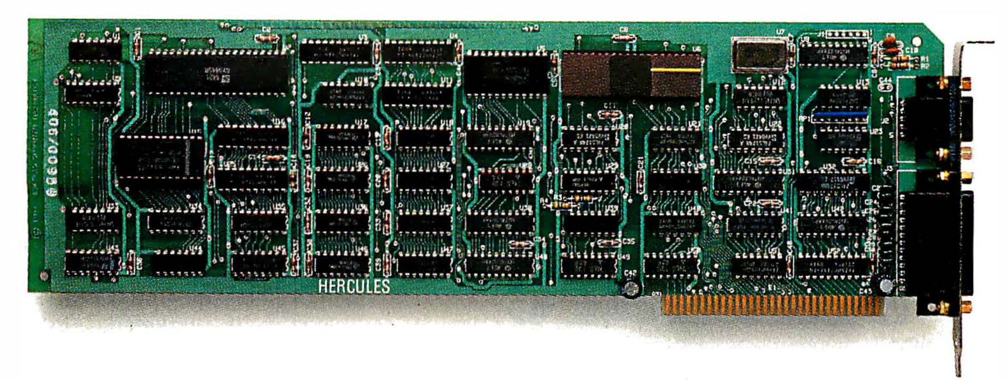
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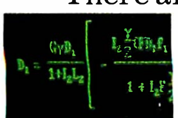
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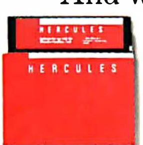
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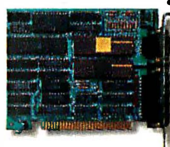
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The article "Faster FORTH" is one-quarter right. It basically gives two methods for speeding up a FORTH language.

If you thread CALL statements instead of just addresses you will avoid numerous jumps to the inner interpreter. Short routines may also be coded in line. This saves time at the cost of memory. This method works fine until 64K bytes are reached, at which point any FORTH implementation slows down. Since threading CALL statements uses memory faster, it reaches that limit sooner. Besides, when speed is paramount, you always recode critical sections in assembly language anyway. The threaded-subroutine method is probably faster, but this article overstates the difference.

The article also recommends using four registers as a short data stack. This has two problems. It practically precludes structured programming or recursion. The programmer must keep track of the depth of the data stack at each level, losing transparency. Additionally, this short stack is slower, not faster. The 8088 is normally limited not by internal processing but by memory access time. The instruction cycle count is practically irrelevant. Since it takes 8 bytes of memory access to POP or PUSH a short stack, it is slower than an in-memory stack, which only needs 6 bytes of memory access. My experimental timing indicates the short stack is 20 percent slower.

FRED SINAL
Hampton, VA

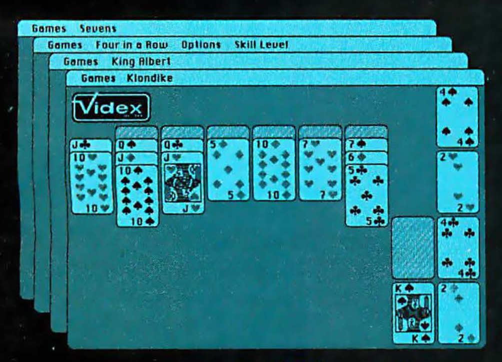
In the search for a "Faster FORTH," Ronald Greene has several valuable suggestions. However, the section of the article concerning data stack should be completely ignored. Mr. Greene discusses a "stack" in four data registers. This setup is, first of all, not a stack. With a stack, one is able to tell whether underflow or overflow has occurred. This important capability is used by FORTH programmers during debugging and then edited out for fastest execution of valid words. I don't see how one could tell if an overflow or underflow had occurred with this register stack without adding back the code that it is meant to save.

The stack allows you to write fully reentrant code. When writing fully recursive definitions in FORTH, the stack and named variables have radically different functions—with the stack holding *all* working variables and the named variable reserved to global functions. Mr. Greene's implementation would virtually eliminate clean-

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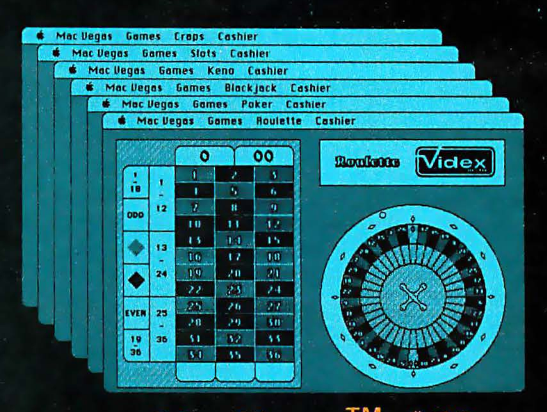
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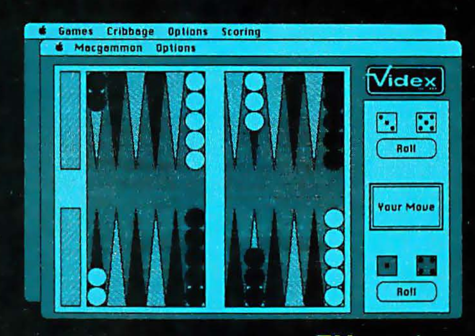
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ly written recursive words. He mentions at the end of his article that his stack in the registers would eliminate one bad style of writing FORTH. It would do that—it would not, however, enforce good style. Good FORTH style has sufficiently factored word definitions so that things are not brought to the stack until necessary. Each word that is essentially a stack manipulator is short enough to have a clear function and is named to suggest its function so that the "long list of stack operations" in its final form is a description of the operations taking place. I would suggest that in nonreentrant code, eight words of the stack should be considered the limit for a local stack picture. FORTH's greatest flexibility comes from the use of the stack as a local software bus. Mr. Greene's problem in the end is that he is using a chip with limited support for data stacks, and unless he is willing to get a 68000 machine, he should recognize the limits of optimization of languages for ill-suited microprocessors.

BRUCE MCFARLING
Granville, OH

First let me apologize to Mr. Garwood and others who found my nonstandard use of the word 2DUP confusing or distracting. I was interested in comparing subroutine threading with the pointer threading proposed by R. G. Loeliger in Threaded Interpretive Languages, *and I followed his discussion so closely that I used the same example of DUP DUP and gave it the same name. Because I had promised that my high-level examples would use FORTH syntax, I should have given the secondary word a different name.*

Four of the letter writers mentioned the central-processor internal short stack that I proposed. One common argument is that use of the short stack would preclude recursive programming. This forces me to concede that the short stack is not acceptable for a language with the full power of FORTH. However, there are other, more limited uses for programming with threaded code in which recursion is not critical. For example, I am working on an extended (and extensible) calculator program written using threaded code: most of the things I will use it for would not benefit from recursive capability. Mr. Sinal worries about the programmer having to "keep track of the depth of the data stack at each level." I have found that if I don't keep track of the stack depth in a regular FORTH implementation, I invariably end up with the machine in limbo because of stack overflow or underflow. The short stack just means that I don't have to count to more than four. Also, for Mr. McFarling's benefit, it is possible to use a marker to indicate the bottom of the short stack that would suffice for most debugging.

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Siemens inkjet	826
Silver Reed 400P	327
500P	377
770P	866
Star Gemini 10x	273
Gemini 15x	375
Delta 10	358
Delta 15	484
Radix 10	534
Radix 15	613
Powertype	333
Tally 160L. w/tractor	560
180L. w/tractor	715
Spirit 80	329
Teletex 1014	389
Texas Instr. TI810 basic	1.173
TI855	745
Toshiba P-1340	725
P-1351	1.299
Transtar 120 P or S	408
130 P or S	549
140 S	1.199
315 color	549

PLOTTERS/DIGITIZERS

Amdek, X-Y	592
Hitachi HDG-1111. Tiger	698
HDG-2222	3.035
Houston Instr., DMP 29	1.693
DMP40	715
DMP42	2.209
DMP52	3.316
DT11C	650
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101E	1.278
DEC VT100	1.529
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Esprit II	520
Esprit III. color	862
LearSiegler ADM-11	530
Liberty Freedom 110	4491
Freedom 200	530
Freedom 220	670
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QVT102G	486
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QVT108G	693
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925	715
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Mr. Sinal makes a good point regarding execution speed. The fact that sometimes the time required to fetch an instruction is larger than the execution time is too often overlooked by amateurs such as myself. Nevertheless, I believe his conclusion is incorrect because it does not take into account the way a register stack is used. Consider the arithmetic operations, for example. With an in-memory stack the two or three operands are typically popped to registers where the arithmetic is done, and the result is then pushed back to the stack, for a total of three to four PUSH/POP operations. With the short stack that I proposed the operands are already in the arithmetic operation (with perhaps an XCHG necessary if the AX register is called for). In this case one or two PUSH/POP operations is more typical.

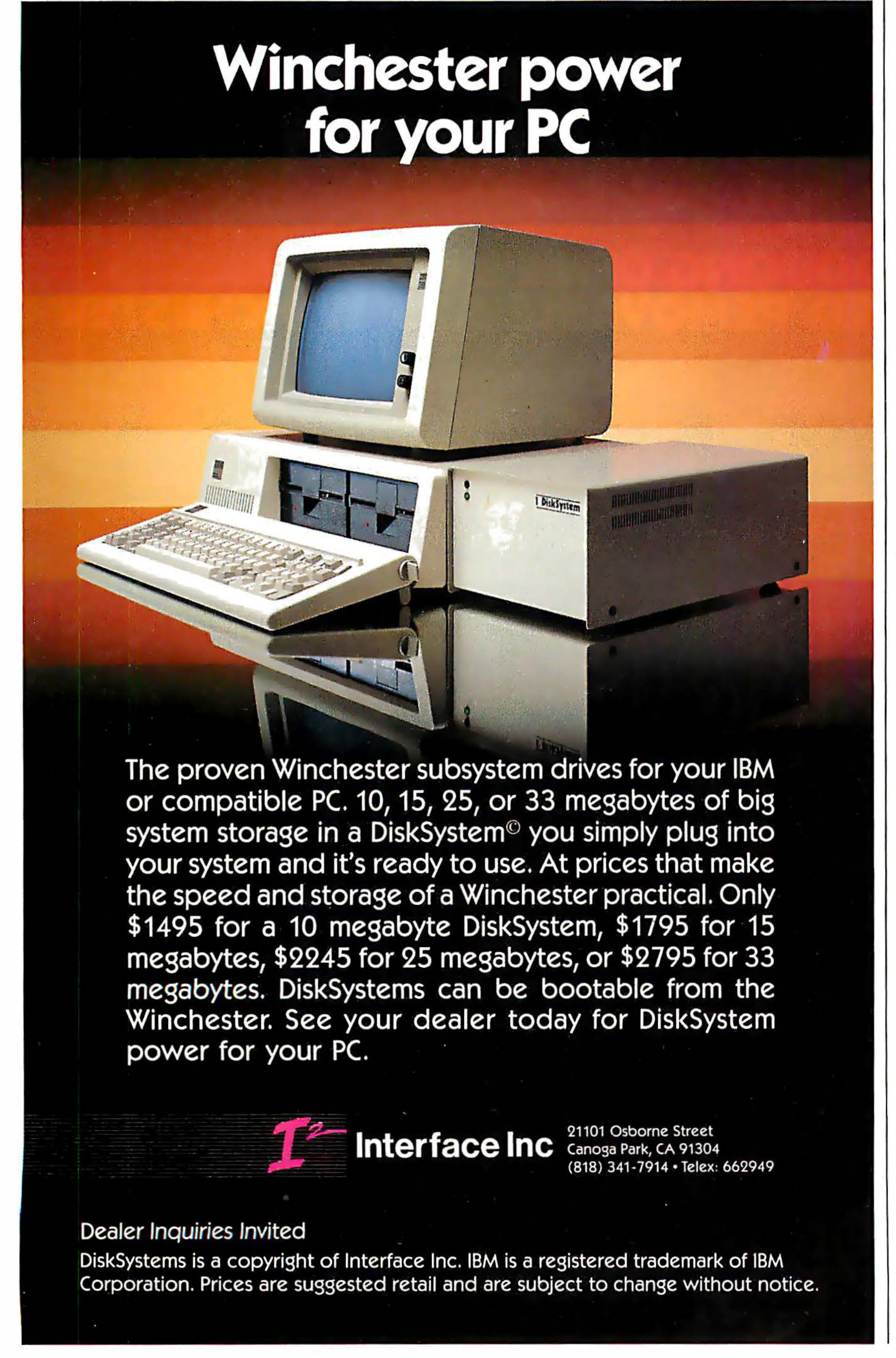
The letter by Mr. Callahan contains a number of relatively minor points regarding my comparison between subroutine threading and the pointer threading suggested by Loeliger. Since the major point of his and Mr. Burger's letters is that there is a much more efficient way of threading pointer code than that illustrated by Loeliger, my replies to these particular comments would be moot. Let me just say that I believe my overall evaluation of subroutine-threaded code in comparison to threaded code, which uses an inner interpreter, is fair. It was based primarily upon actual benchmark comparisons between my subroutine-threaded version of FORTH with a short stack and the IBM PC version of FORTH Level II distributed by FORTH Technology. To the best of my knowledge, it is among the fastest FORTHs available for the IBM PC. The comparisons I made were an attempt to explain qualitatively why subroutine threading was faster in terms of a readily available implementation of pointer-threaded code (Loeliger's book).

I found Mr. Burger's letter and the last part of Mr. Callahan's letter most interesting because they sketch a technique of pointer threading that does not require an inner interpreter. The technique is not widely known, judging from the speed of the FORTH compiler/interpreters on the market. It has almost all of the advantages of subroutine-threaded code but few of the disadvantages. It is also possible to partially implement macro coding (as I discussed in my article) to define primitives at the user level.

The technique suggested by Messrs. Burger and Callahan (tight threading) does not use an inner interpreter in the usual sense of the word. Burger's version of tight threading is the more efficient of the two, and is also most closely related to subroutine threading, so I'll concentrate on it. Ignoring secondaries for the moment, in the usual implementation of FORTH, when a primitive finishes executing, a jump is made to a short routine called the inner interpreter. This routine performs some housekeeping and then causes a jump to the next primitive. Subroutine threading uses a CALL/RET pair to complete these two jumps, and uses the hardware of the processor stack to handle the housekeeping. With tight threading, on the other hand, there is a single jump from the end of one primitive to the beginning of the next, thus saving one time-consuming jump. The necessary housekeeping is done at the end of the primitive, just before the jump to the next primitive. Like subroutine threading, Burger uses the stack hardware for housekeeping so the only overhead necessary (to complete the jump) is a RET statement.

As I mentioned earlier, the tight-threading technique can be adapted to partially utilize macro coding. One way of doing this would be to define a second compiler (perhaps ": :") that would copy executable code, rather than a list of addresses, into the word being defined. A word so defined would be a user-created primitive and would not have the additional overhead of a secondary, nor the overhead of the RET statements of each of its constituents.

RONALD L. GREENE
New Orleans, LA ■



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UPDATES

UNIX Benchmarks Brought Up to Date

David F. Hinnant, whose article "Benchmarking UNIX Systems" appeared in the August BYTE (page 132), laments that "for some reason the most impressive benchmarking results always seem to arrive after the publication deadline. Such is the case with the SCI-1000. The product configuration far outperforms the preproduction version in most respects."

The most notable performance increase was found with the multiuser-simulation benchmark. The results for the multitasking UNIX benchmark with a variable number of background processes were presented in table 3 (page 407). The new data for the SCI-1000 running UNIX System III is shown here in table A.

Table A: *The multitasking* UNIX *benchmark with a variable number of background processes produced these results on the production version of the* SCI-1000. *The data is the elapsed (i.e., real) times for the benchmark to complete its cycle.*

	AVERAGE ELAPSED TIME IN SECONDS					
UNIX Version	Number of Concurrent Processes					
System III	1	2	3	4	5	6
	5.5	8.9	12.3	16.9	21.9	28.1

Table B: *The other* UNIX *benchmarks given in the August* BYTE *produced these results on the production version of the* SCI-1000 *running* UNIX *System* III.

TIME IN SECONDS

1. Pipe			2. System Call			3. Function Call	4. Sieve		
real	user	system	real	user	system	real	real	user	system
7.7	0.0	3.3	24.3	0.9	23.1	1.2	4.1	3.6	0.1

5a. Disk Write	5b. Disk Read	6a. Shell			7.Loop		
real	real	real	user	system	real	user	system
5.0	13.9	4.9	0.0	2.8	14.1	13.6	0.1

The new results place the SCI-1000 in the number six position, ahead of the Altos 986 and the TRS-80 Model 16B, both of which ran versions of XENIX. Mr. Hinnant anticipated this result due to the fact that the SCI-1000 is based on the 80186 microprocessor. Other benchmarks displayed a similar increase in performance. Substitute the data in table B here for that listed for the SCI-1000 in table 1 (page 135).

Curiously, the new times for the disk write and read (listings 5a and 5b, page 404) are somewhat slower than those achieved with the preproduction version. However, the slower speed doesn't seem to affect the overall performance of the system; e.g., the shell test (listing 6a, page 406) executes in substantially less time.

"With a price of around $10,000," concludes Mr. Hinnant, "the price/performance ratio for the SCI-1000 is competitive with the Altos 586 or Altos 986." He adds that because the same company produced the UNIX port for the PC/IX and the kernel for the SCI-1000, it should be easy to create application programs for an IBM PC running PC/IX on the SCI-1000.

Benchmarks Run Well on Lisa 2/10

Wilf Sullivan from Carleton University in Ottawa ran David Hinnant's UNIX benchmarks on a pair of Apple Lisa 2/10s. In some cases, the results were considerably better than those obtained by Mr. Hinnant, who ran his benchmarks on a 1-megabyte Lisa. (See "Benchmarking UNIX Systems," August, page 132.)

The benchmarks were run on 1- and 0.5-megabyte Lisa 2/10s using Microsoft's XENIX. The results for the Pipe, System Call, Function Call, and Sieve benchmarks are comparable to those obtained by Mr. Hinnant. However, the Disk Read, Disk Write, and Shell benchmarks are faster. (The data for the Shell test on the 1-megabyte Lisa 2/10 is unavailable.)

With respect to multitasking performance, the 1-megabyte Lisa, according to Mr. Sullivan's survey, should rank among the top seven machines when rated on the fastest execution of a real-time task. Those results are shown in tables C and D.

(continued)

Table C: *The* UNIX *benchmark results on a* 0.5-*megabyte Apple Lisa* 2/10 *running* XENIX.

AVERAGE ELAPSED TIME IN SECONDS

5a. Disk Write	5b. Disk Read	6a. Shell (tree-run sample)			6b. Multitasking UNIX Benchmark	
					Number of Concurrent Processes	
		real	user	system		real
13.5	24.5	12.3	0.5	4.3	3	51.5
					6	2:02.2

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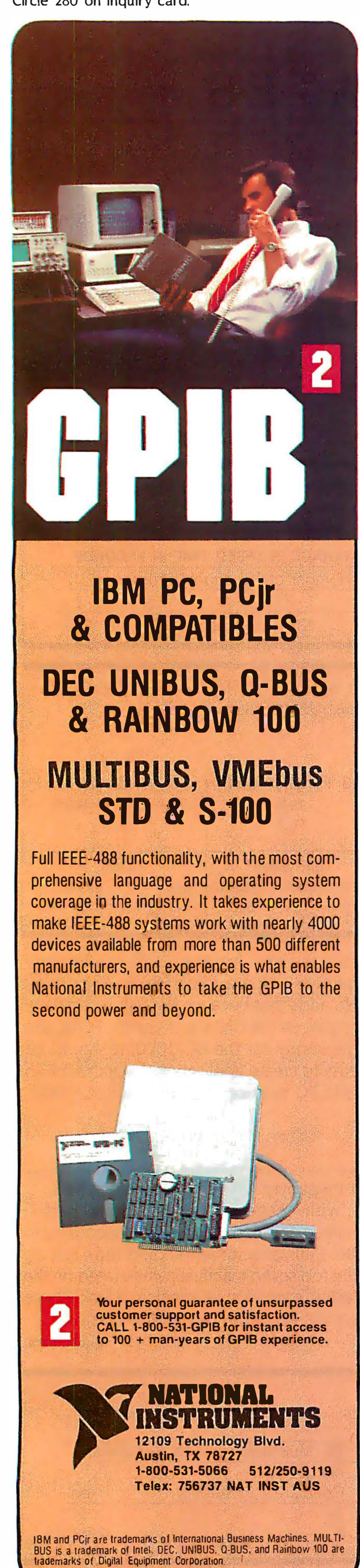


Table D: *The UNIX benchmark results on a 1-megabyte Apple Lisa 2/10 running XENIX. (Please note that data for the Shell benchmark is unavailable.)*

AVERAGE ELAPSED TIME IN SECONDS

5a. Disk Write	5b. Disk Read	6b. Multitasking UNIX Benchmark Number of Concurrent Processes	real
13.7	23.7	3	26.0
		6	48.9

Chip Choice Explained

Professor Marvin L. De Jong was surprised that Richard C. Hallgren used an AD7570 A/D converter in his automated data-acquisition system. (See "Putting the Apple II Work, Part 1: The Hardware," April, page 152.) He felt that the AD571 would remove much of the complexity of the circuitry involved. However, he notes that the chips are similar, except that the AD571 has 10 fewer pins, a shorter conversion time, and an internal clock.

Mr. Hallgren replied that he chose the AD7570 over the AD571 because of the speed he wanted to achieve. He felt that his best approach would be to parallel the converters. This would allow them to convert their respective input signals simultaneously, eliminating time that would otherwise have been wasted by multiplexing the input signals to the input of a single converter. Since the output of the AD7570 is three-state buffered, all three outputs could be wired to the Apple's data bus and then successfully read in by the machine-language routine. The AD571 would require the addition of three-state buffers if it were used in this manner.

BYTE'S BUGS

Aliasing Error Foils Analysis

Rob Spencer found an aliasing error in his cluster-analysis program. (See "Cluster Analysis," September, page 129.)

"Though the program worked dozens of times of my NEC PC8001 and also on a friend's Apple II+," writes Mr. Spencer, "it didn't work . . . when I brought it over to a Macintosh."

The bug appears only in certain dialects of BASIC. Although the variables DM and DMIN are meant to be the same, as they are in Apple II and NEC BASIC, they do not function correctly with BASICs that use the whole variable name, including Microsoft BASIC for the Mac.

Please substitute DMIN for DM in lines 470 and 690 in listing 1 (page 423).

New Numbers on Database Specifications

Some errors crept into the table in "A Database Catalog" (October, page 227). The Sensible Solution from O'Hanlon Computer Systems Inc. (Bellevue, Washington) allows a maximum of 1000 fields per record, 17 million records per file, and 16 files open at once. Also, it can be used in a multiuser system. FilePro 16 from the Small Computer Company Inc. (New York, New York) allows a maximum of 16 million records per file.

Say It Right

The introduction to the October Features section (page 107) was struck by production gremlins, who altered the meaning of the last sentence in the first paragraph. The sentence should read: "Alas, the AT *keyboard* cannot be used with prior-model Personal Computers."

Memory Lapse

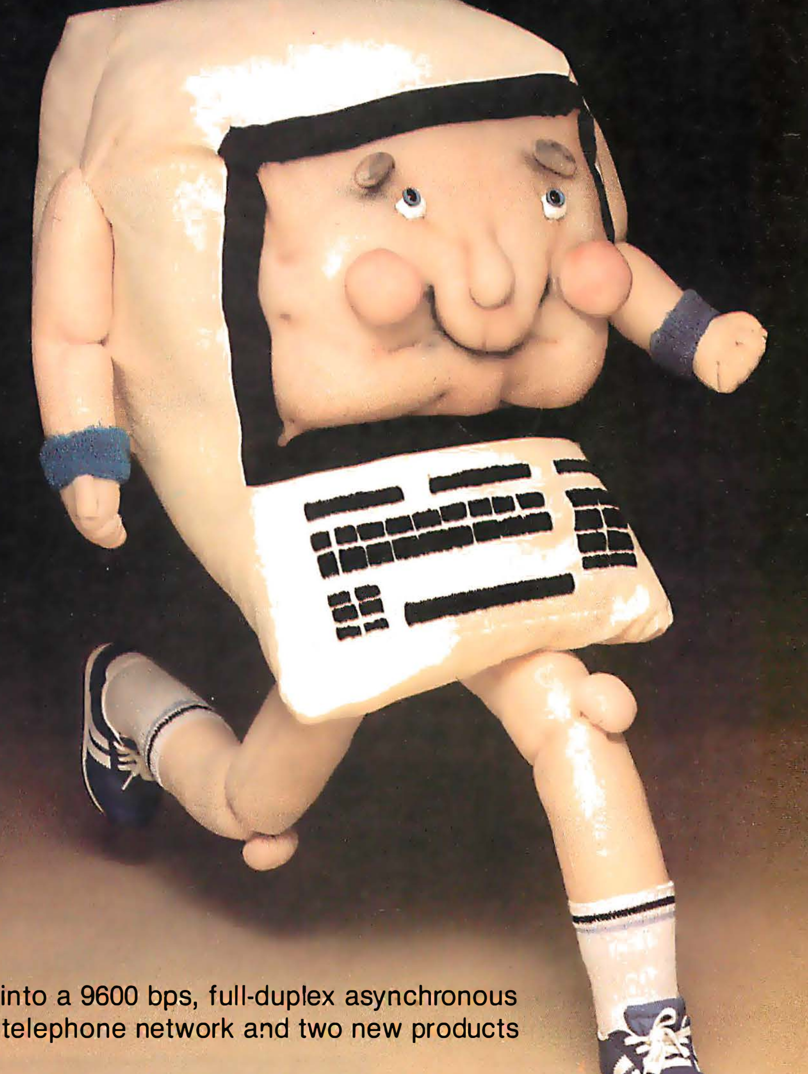
We misstated the memory capacity of the Menos I Robot Control System in the September What's New section (page 472). The total memory space available on the main circuit board and slots can be expanded to 102K bytes. On the motherboard alone, ROM and RAM capacities are expandable to 16K bytes.

Faulty Caption Corrected

A figure caption in the Software Review "LISP for the IBM Personal Computer" inaccurately refers to a listing. (See July, page 281.) The caption for figure 1 (page 286) should have stated that the tree shown represents the list ((JOHN AND JORDAN) HACK (C AND LISP)). The figure shown has no relationship to listing 1.

Our thanks to John Diamant, who coauthored the article with Jordan Bortz, for spotting the error. ■

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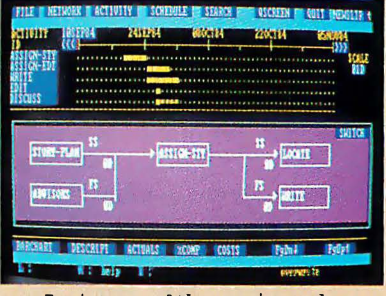
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NEC Unveils Notebook Computer

The NEC PC-8401A is a seven-pound notebook computer with a 16-line by 80-character liquid-crystal display. Also included are a 300-bps modem, parallel and serial ports, a Z80 processor, and 64K bytes of RAM, of which 32K bytes is always available for any application software.

A built-in expansion slot can be used to attach an optional 1200-bps modem, a CRT adapter to connect a standard monitor, or a 32K-byte RAM cartridge. A data recorder and one or two 3½-inch floppy-disk drives can also be added.

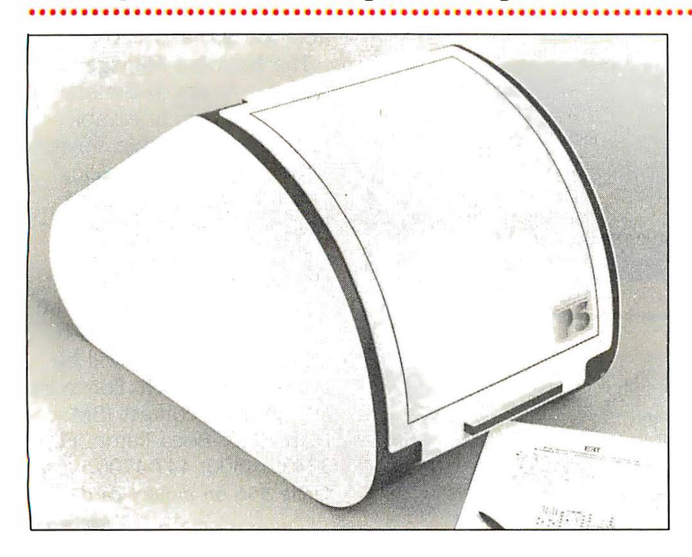
The system has 80K bytes of ROM, featuring MicroPro's WordStar-To-Go and Calc-To-Go, NEC's Personal Filer, telecommunications software, and the CP/M 2.2 operating system. BASIC is not included with the system.



According to NEC, the PC-8401A will be available this month for $995. For further information, contact NEC Home Electronics Inc., Suite 10, 700 Nicholas Blvd., Elk Grove Village, IL 60007, (312) 228-5900.

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Desktop Scanner Can Digitize Images and Read Documents



Electronic Information Technology's Personal Scanner (EIT-PS) is an automatic graphic digitizer and text-input device. It can either perform optical character recognition or digitize images.

EIT-PS consists of the desktop scanner, a cable, and a half-size card for the IBM PC. It costs $2487. Versions for Apple computers are planned for early 1985. Contact Electronic Information Technology Inc., 373 Route 46 W, Fairfield, NJ 07006, (201) 227-1447.

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Graphics Environment Manager

Digital Research's Graphics Environment Manager (GEM) is a single-tasking graphics user interface for MS-DOS computers. The operating environment has features similar to those found on Apple's Macintosh, such as pull-down menus, icons, and variable-size windows, and includes color graphics.

GEM operates as an extension to the MS-DOS operating system. Makers of MS-DOS computers must adapt the graphics portion of their operating system for each machine. The manufacturers pay a one-time fee for unlimited rights to distribute GEM with their MS-DOS computers.

Digital Research also announced three presentation graphics packages that will operate under GEM. GEM Wordchart can be used for text presentations using a number of type styles and formats. Pictures can be drawn with GEM Draw software, which adds the GEM user interface to the DR Draw program. GEM Presentation Master bundles GEM Draw, GEM Wordchart, and DR Graph with the Polaroid Palette image recorder.

According to the company, these programs should be available for MS-DOS in early 1985; a version that will run under DR's Concurrent PC-DOS is also planned. For further details, contact Digital Research Inc., 60 Garden Court, POB DRI, Monterey, CA 93942, (408) 649-3896.

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(continued)

Relational Database Requires No Programming



Cornerstone is a relational database for the IBM PC that allows you to add fields, incorporate data from other Cornerstone files, and check the validity of entered data from an easy-to-use menu-based interface. Billed by Infocom as "the sophisticated database system for the non-programmer," Cornerstone lets you enter data into separate database files in a loose structure that can easily be changed later.

The database size is limited by the capacity of the disk. Storage of 8,000,000 characters per file with 120 files per database is possible. Cornerstone commands are typed in by the user or can be selected from a menu; the menu can be deleted for experienced users. Fields can contain from 1 to 255 values. All text fields are of variable length, and files can be stored on any field. Data is automatically checked during input.

Cornerstone includes a context-sensitive help function that provides information given by the user when defining the file. This information explains the function of a key or command in the context of the file being used.

An interactive report writer lets you quickly define the layout of a report on the video display. Using that layout, you can print selected records from a file or save the layout for later use.

Cornerstone can read pfs:File and dBASE II files and can exchange data with Lotus 1-2-3, WordStar, and other word processors and spreadsheets.

Cornerstone runs on the IBM PC family and compatible computers; PC-DOS 2.0 or later, at least 256K bytes of memory (512K bytes is recommended), and two disk drives are required. Infocom plans to release Cornerstone in February for $495. Contact Infocom, 55 Wheeler St., Cambridge, MA 02138, (617) 492-1031.
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QX-16 Features Valdocs 2

Epson's QX-16 includes dual 8088 and Z80 microprocessors, 256K bytes of RAM expandable to 512K, 640- by 400-pixel graphics, and the MS-DOS, CP/M, and Valdocs operating systems. Two 5¼-inch disk drives store 360K bytes of data in MS-DOS format or 720K bytes in CP/M.

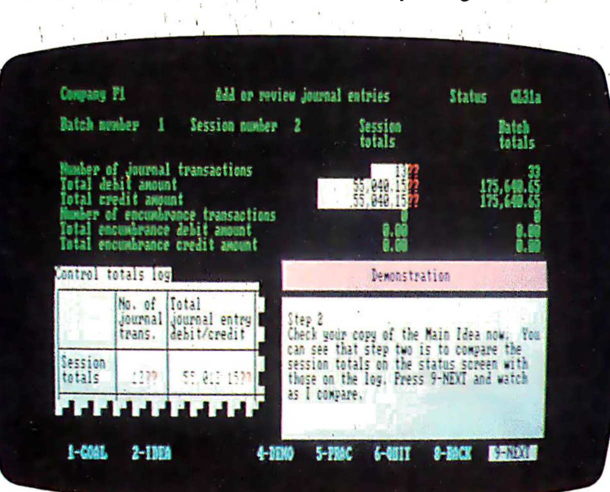
Bundled with the QX-16 (and the QX-10) is an enhanced version of Rising Star Industries' Valdocs operating system. Valdocs 2 is faster than the original and has an expert mode so that experienced users won't be frustrated by the normal menu-driven format.

The Epson QX-16 will cost less than $3000. For details, contact Epson America, Computer Products Division, 2780 Lomita Blvd., Torrance, CA 90505, (213) 539-9140.
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IBM Announces Productivity Software

IBM has introduced the Business Management Series and the Personal Decision Series, two lines of integrated software for the IBM PC. Also available from IBM are attachments for these packages to enable file transfers to IBM System/36, 370, 4300, 303X, and 308X computers using the MVS and VM operating systems.

The Personal Decision Series comprises five application programs, with Data Edition, a database manager priced at $250, as the required central module. The related packages are Reports+ Edition, a $150 report generator; Graphs Edition, a $200 graphics program; Words Edition, a $150 word processor; Plans Edition, a $150 spreadsheet program with graphics; and the $300 Plans+ Edition, an advanced version of Plans. Training modules are available for $60 and $70.



The Business Management Series consists of General Ledger, Accounts Payable, Accounts Receivable, Payroll, Order Entry and Invoicing, and Inventory Accounting Editions for $695 each. Training programs for each module are $95 each.

IBM expected most of the products to be released by this month; Plans+ will be available in March. For more information, contact IBM, POB 1328, Boca Raton, FL 33432, (800) 447-4700.
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(continued)

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There's a notepad that has a full-screen editor that can time and date stamp your notes, and then save them to disk. You can even pull information into the notepad directly from the screen of your "underlying" software.

Suppose you're working in Lotus and the phone suddenly rings. Give your Sidekick a call and it pops right up over Lotus with the notepad you need. Or an appointment calendar . . . one you can never misplace.

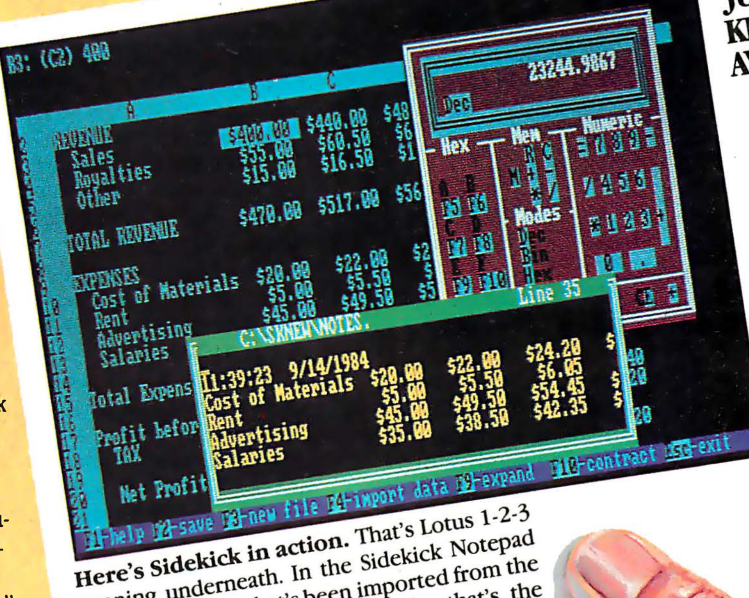
What if you need to do a quick calculation? A keystroke instantly brings up the calculator. And the results of your calculations can even be transferred to your "underlying" software.

Need to make a phone call? Up pops your personal phone directory. Type in the name you want . . . and Sidekick jumps right to the phone number. Another keystroke, and the phone is automatically dialed for you.**

There's lots more, too. You can move the Sidekick windows anywhere on the screen you like. And you can have as many on screen at a time as you need. There's even an on-line help window for each of Sidekick's features.

We designed it because we needed it. If you've ever been writing a report and needed to do a quick calculation, or jot down a note, then you need Sidekick, too.

**Only with Hayes Smartmodem and compatibles.*



Here's Sidekick in action. That's Lotus 1-2-3 running underneath. In the Sidekick Notepad you can see data that's been imported from the Lotus screen. On the upper right, that's the Sidekick Calculator.

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Osborne Introduces Vixen, Emerges from Chapter 11



Osborne Computer Corporation, which expected to emerge from Chapter 11 protection by this month, introduced the Vixen portable computer. The Vixen features a 7-inch amber display, two 390K-byte disk drives, 64K bytes of RAM, a 4-MHz Z80A microprocessor, and parallel and RS-232C serial ports. Bundled with the system are the CP/M 2.2 operating system, WordStar 3.3, SuperCalc 2, MBASIC, and Desolation, a game program. Also included are Osboard software, for drawing graphics, Media Master, to transfer information to MS-DOS format disks, and Turnkey, to change some system features.

The Osborne Vixen is priced at $1298. Optionally, an external 10-megabyte hard disk may be added to the Vixen; with an interface card, the hard disk is $1498. For more information, contact Osborne Computer Corp., 42680 Christy St., Fremont, CA 94538, (415) 490-6885.
Circle **557** on inquiry card.

Quadram Adds Software Line

Quadram's new Quadsoft software line includes word-processing and database-management programs for the IBM PC and compatibles, as well as add-on products for Lotus 1-2-3 and Symphony. All are based on products developed by XQ Software and Select Information Systems.

Freestyle, an outline-based word processor, has drawing capabilities and a spelling checker. Its "outline zoom" lets you organize many pages of text in an outline format on a single screen. Freestyle costs $295 and requires MS-DOS 2.0, 192K bytes of RAM, and two double-sided disk drives.

A retrieval system, 4-1-1 creates a word database or index of documents composed with word processors, such as WordStar. 4-1-1 is $149 and requires 256K bytes.

The Executive Organizer uses icons to select note pad, alarm clock, calendar, phone directory, and calculator functions. It also serves as an environment to execute, print, or erase other files. The Executive Organizer is $99 and requires 256K bytes of RAM.

Also released were Select Write: Word Processing 101, a $99 menu-driven word processor; Bilingual, a $395 Spanish/English word processor; and a line of Expert Writing Guides ($50 each).

The Data Base Manager is a menu-driven database-management system that can be linked to many spreadsheets and word processors. It costs $295 and requires only a 128K-byte IBM PC with at least 360K-byte disk capacity.

For users of Lotus 1-2-3, the Key to Data Management, $99, provides additional menus and options to make functions easier to implement. Symphony users can buy a $129 Report Generator and a $119 Starter Kit that contains sample templates.

Other new items are the Investment Strategist, for $295, the Tax Strategist, also $295, and the Deadline Manager, a project-management system for $149.

Contact Quadram Corp., Quadsoft Division, 4355 International Blvd., Norcross, GA 30093, (404) 564-1975.
Circle **558** on inquiry card.

TeleVideo Personal Mini Links PCs, Workstations



The Personal Mini PM/4T is a four-user version of TeleVideo's multiuser IBM PC-compatible computer. The PM/4T features 80186 and Z80A microprocessors, a 20-megabyte hard disk, a floppy-disk drive, and a 20-megabyte tape-cassette drive. TeleVideo's InfoShare operating system for the Personal Mini can run many multiuser programs or execute most single-user MS-DOS and PC-DOS programs.

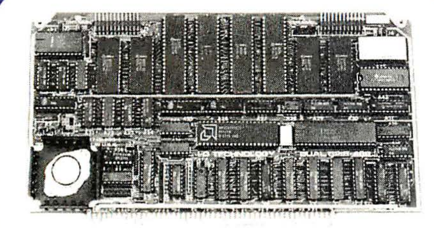
The PM/4T can be linked to four personal computers or workstations, including IBM PCs or compatibles or TeleVideo's PM Workstation. Two RS-232C serial ports, four RS-422 serial ports for workstations, and one parallel printer port are provided.

The TeleVideo PM/4T will cost under $6000; a 16-user version is about $9000. A $99 interface card is required to connect each personal computer to the system; PM Workstations cost $1995 each. Contact TeleVideo Systems Inc., 550 East Brokaw Rd., San Jose, CA 95112, (408) 971-0255.
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(continued)

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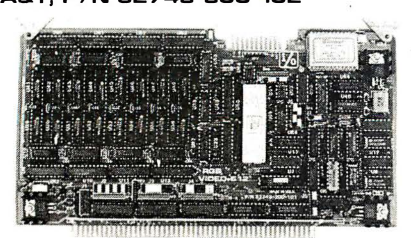
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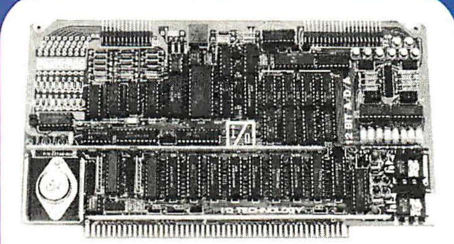
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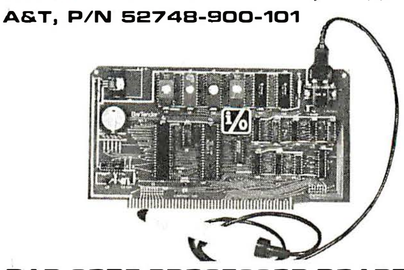
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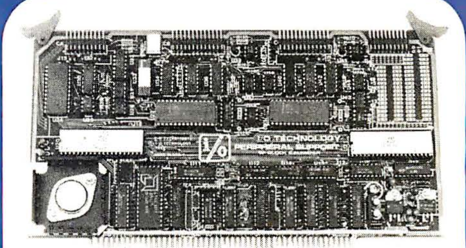
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BAR CODE PROCESSOR BOARD

The BarTender is a stand-alone I/O Processor that reads and prints most common Bar Codes. Includes bi-directional reading, wand interface, clock/calendar with battery. Extensive documentation and software.

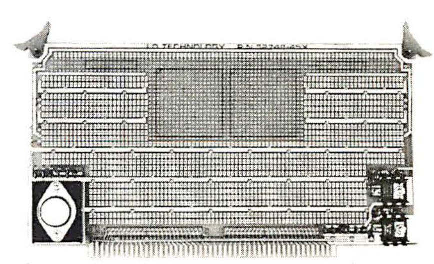
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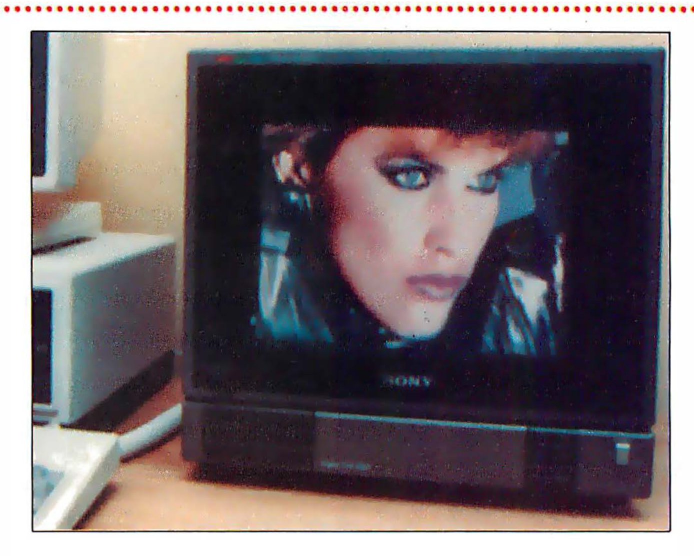
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Graphics Products for Image Capture and Enhancement

AT&T Consumer Products announced three graphics products for the AT&T 6300 or IBM PC: a high-resolution color graphics card, an image capture card, and a NAPLPS videotex decoder card.

The Video Display Adapter has two color graphics modes: a 256- by 256-pixel mode displaying 256 colors from a palette of 32,768 colors and a "high spatial-resolution mode" showing 512 by 256 pixels in 8 colors with two intensity levels per color. The card can be used to display 80-column text on an analog RGB monitor; a composite output is also provided.

The Image Capture Board is a high-resolution frame grabber and buffer that can capture, digitize, and display images from a composite video signal source. The card captures images with a resolution of 256 by 256 pixels in 32,768 colors, storing the image in 128K bytes of RAM.



The Personal Computer NAPLPS Decoder can be used with any AT&T or IBM-compatible computer to display color images encoded in the North American Presentation Level Protocol Syntax (NAPLPS). The card can also be used to emulate AT&T's Sceptre terminal.

These products can be purchased only by other manufacturers. The Video Display Adapter will be available by mid-1985 for about $500. The Image Capture Board, scheduled for a December release, will cost about $1000. The NAPLPS card, available now, is about $600. For further information, contact AT&T Consumer Products, 5 Wood Hollow Road, Parsippany, NJ 07054, (201) 581-3000.

Circle **560** on inquiry card.

Security System Includes Speech Synthesizer and Software

The Peace of Mind Master Controller is a complete home security system for use with the IBM Personal Computer. The controller is a standard IBM PC expansion card with 16 inputs for sensors or wireless receivers, 8 relay outputs for alarms or speakers, and control ports for up to 16 lights or electrical applicances. Also included is a speech-generation system with 300 words on disk.

The system can be connected to a number of optional devices. Planned for January release is the Communicator board with an auto-dial/auto-answer 300/1200-bps modem that can make unattended voice or data phone calls. Other devices include a universal power supply, infrared wireless transceivers, smoke and glass break detectors, and medical alerts.

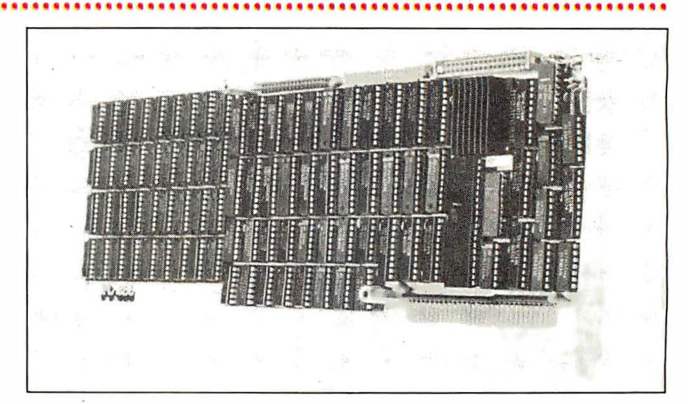
The expansion card costs $695 and comes with security software as well as bundled word processing, spreadsheet, and database programs. The firm estimates that a typical hard-wired system will cost $900, while a system using a wireless transmitter and receiver will cost from $1200 to $1500. Contact Gestalt Technocracy, Suite 4, 874 Henry Street, Arnold, CA 95223, (800) 235-6646 ext. 599; in California, (800) 235-6647 ext. 599 or (209) 795-3157.

Circle **561** on inquiry card.

Expansion Card Adds 80286 Processor to IBM PC

The PC-286 is a coprocessor card for the IBM PC that replaces the PC's 8088 processor with a 4-, 6-, or 8-MHz Intel 80286. The card also includes 256 to 640K bytes of memory and a socket for an optional 80287 math coprocessor. An optional 512K-byte piggyback card can be added.

A 40-pin connector from the expansion card is plugged into the 8088 socket after the processor is removed; the 80286 then controls the PC bus. An on-board EPROM allows the system firmware to be copied into the 80286 local memory to provide faster program execution. All available software and expansion cards should operate normally with the PC-286. Under software control, the 80286's hardware protection, virtual memory support, and 16-megabyte address space can be used.



The PC-286 card with a 4-MHz 80286 and 256K bytes of RAM costs $2395. Contact Seattle Telecom & Data Inc., 2637 151st Place NE, Redmond, WA 98052, (206) 883-8440.

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(continued on page 432)

Executives' Review & Guide to

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REVELATION™

IBM PC/XT/AT and 3270PC **$950**

Revelation is **the most significant DBMS** product to appear on the IBM Personal Computer series! It has incredible depth and power, and yet us ordinary persons can use and understand it. You just cannot outgrow the system. The limits of Revelation are determined by the power of the PC or AT, not the software.

What do you get? This is a **full relational system**, not just an application. In addition to complete relational DBMS file creation and management, Revelation includes a full Basic Compiler called R/Basic, PC-to-PC and PC-to-mainframe communications utilities (R/Net), text editor (R/Edit), full selective copy function (R/Copy), an applications code generator (R/Design) that allows you to build and use custom data entry screens and reports with a minimum of effort, and a English-like report writer and general purpose retrieval language that can be used for both repetitive and ad hoc reporting or inquiry (R/List). The R/Maker applications generator and Menu system is also available for Revelation that creates a menu-oriented easy to learn environment for us less experienced users.

Where did Revelation come from? There are two operating systems that have been fighting the last 10 years for market share in the mini and mainframe world, UNIX™ and the PICK/OS™. Revelation is a highly extended emulation of the Pick/OS that runs under standard MS-DOS. Revelation was designed to implement business systems that can be maintained by business people, not programmers.

How does it work? First, Revelation expects you to change your mind, so you don't have to define your entire database schema at the start (we leave our "schema" in the garage). You use the data **dictionary** to add fields or relationships without redefining or reloading or touching the data! That's it. . . **virtual fields** (computed or joined on the fly) are available without creating a separate working file. You can even use this feature to access one record at a time—onscreen **dynamic joins.** Users of most other databases just broke into tears of joy.

Next, Revelation **variable length files** containing variable length **records** (items), each record containing a variable number of variable length **fields** (attributes), each field containing a variable number of variable length values, and each value containing a variable number of variable length **sub-values.** Say that three times fast. An example—you could have a personnel file with one field named "Children" where you record the names of each of the employees' children. Easy to do, just define the field as Multi-Valued in the dictionary and you can have *any number of entries in that field.*

You have to picture Revelation records as multi-dimensional. (There are seven dimensions, but normally you would only use three.) This concept of dimensions is real useful in business applications where you have multiple transactions (or line items) per master record. Invoices could be single records with each line item stored as a group of multi-valued fields that are associated to other fields (quantity, description price, units, extended price, etc.). Obviously this capability saves enormous amounts of disk space and simplifies your database design. There is **no limit to the number of entries** except that the entire record cannot exceed 65,000 characters. **The files can** be any size, except the entire system including all files and programs can't exceed the address space of 2.4 billion characters (if your disk is larger than that, please call us immediately).

All this is great, but is it usable? What you really need is a way to access only the data you want. Revelation has a dynamic report writer that makes it extremely easy to display or print reports. You use simple sentences like "SORT INVOICES BY CUSTOMERS WITH AMOUNT.DUE > "0" AND WITH DATE.DUE < "1/15/84" DISPLAY THE COMPANY.NAME AMOUNT.DUE INVOICE.NUMBER "PHONE". You would immediately get a report in customer order on your screen or on your printer that your credit department could start calling from. Not only do you get the report, but you can request that the R/Basic source code that created the report to be generated and saved for change later. . . a code generator at no extra charge!

R/Basic? R/Basic is the powerful user programming language integrated with the Revelation Database environment. You don't need to use R/Basic for standard or easy data management functions, but it is there when you begin to exceed the capabilities of the standard systems. With it you can **program almost any application.** It is a highly structured language that contains all the features of languages like C, Pascal, or PL/1.

Revelation completely supports the 8087 co-processor in the IBM. The 8087 can be used extensively by the Database and R/Basic to maximize the speed of the system. We recommend that you get an 8087 for maximum benefit.

If you (like us) don't want to program, Revelation has a menu and screen building system included. You do not have to learn a complex procedural language. If you want complete hand holding, see our discussion on R/Maker. **Unlimited flexibility** and the ability to move your files up to mini or mainframe computers makes Revelation totally without equal. We recommend Revelation for everyone who will outgrow their file handling system and is willing to spend 8 hours learning a product that they will never outgrow.

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(Revelation continued)

Applications: In the beginning you create a mail list...then you use the same data to create your customer list...which becomes your accounts receivable file and your reference list and part of the data becomes your general ledger and your balance sheet and then grows into a complete business management system which you run on your hard disk which then you integrate into your local area network which grows into your national management information system which becomes the kernel for your international Euro-America management system...if you get the feeling that there is no end in sight, then you are beginning to understand the power of Revelation.

Capacity: Records: Limited only by disk capacity, addresses up to 2.4 Billion Bytes. Record Size: Maximum of 65,000 characters each. Fields: Maximum of 65,000 per record. Variables: Maximum of 65,000. Files: Limited only by disk capacity.

Requires: IBM PC/XT/AT, Columbia, Compaq, and many other compatibles. 8087 or 80287 optional and fully supported. MS-DOS or PC-DOS, 1.1, 2.x and above. 320KBytes of main memory. 512K recommended. Requires 2 320K floppy disks or compatible hard disk.

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Four User	$1,495
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Upgrade from single user Revelation	Call

You need a driveway for your data, then there is Revelation—for a freeway we have Network Revelation. The best database will be available in January as a **networking, multi-user DBMS with record locking and resource sharing.** Files can be in your local PC, remote PCs, or even on a minicomputer.

Network Revelation allows files to be shared and data **relationships** to be established **across machine** boundaries. Consolidations of data from many-to-one for reports become easy. All the resources of the machines in the net become available for the database to use. Frame locking provides complete data security, with all the normal user rights and checks. What if your database is too large for the normal PC network capabilities, or if you really need a transaction oriented environment? From the freeway to the friendly skies. . . we have a solution. Call us for complete information.

Revelation PLUS
Ease of Development and Use . . .

R/Maker ™

Requires Revelation DBMS	$175
When ordered with Revelation. . . .	$45

What could R/Maker do that Revelation can't? R/Maker takes you through the first 6 days of creating your application with Revelation so you can rest on the 7th (and it makes all 7 days happen in 4 hours!).

R/Maker is an **interactive menu and screen creation/update system.** It supplements and magnifies Revelation's power and completely interfaces with alnost all Revelation features. You can start out with R/Maker and completely create your applications using it. R/Maker screens were designed by a graduate of the "Pong" and "Invaders" school of computer users. The fields appear in a window and you point to the fields you want on your screen. The screen is automatically created (no programming), and then you can push and shove fields and labels around like a video game to get the screen the way you want it.

With the R/Maker interface you can create systems, execute batch commands, update files, run reports, call other menus, make your own custom menus, run DOS commands or other programs such as 1-2-3 from a R/Maker menu. Besides doing all these functions, you can stack an unlimited number of program steps in a given menu choice so reports and processes happen automatically. R/Maker menus implement **complete security** so you can limit access of programs, menus and functions to those authorized. Applications and aids that take months to create are already done for you.

Want to use your favorite spreadsheet or word processor with Revelation? No problem, R/Maker includes a feature to **load database information to** a text file compatible with the Lotus **1-2-3**™ import files. You can selectively load records from Revelation to 1-2-3™. You can use R/Maker to create files for use in your word processor.

There just is not enough space to tell you of all the capabilities that R/Maker gives you. **Order R/Maker along with Revelation and get a special price and our full guarantee.**

Requirements: Same as Revelation.

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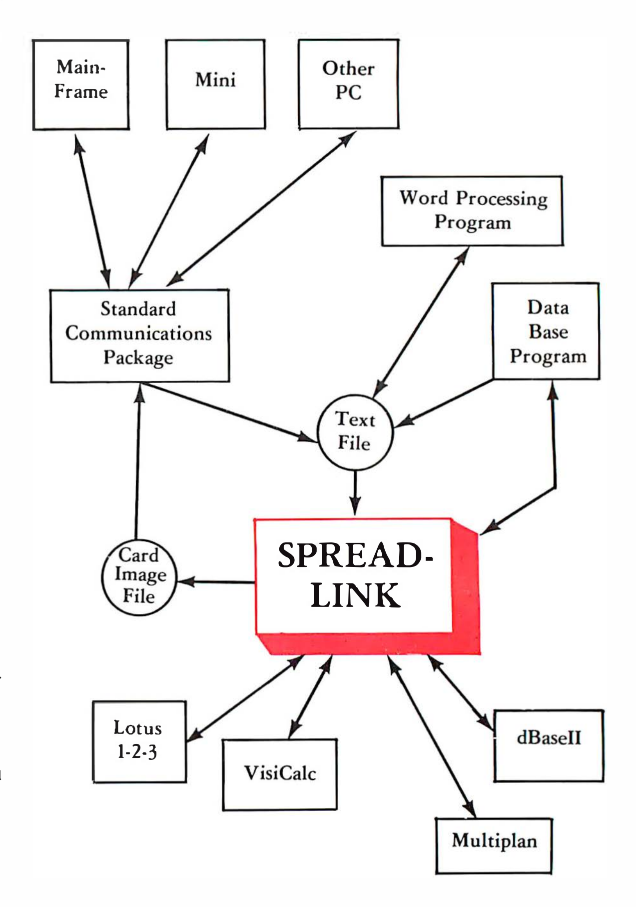
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SPREADLINK™

IBM PC/XT/AT, PCjr, 3270PC **$149**

Instead of entering data by hand from external sources into your spreadsheets or databases, Spreadlink reformats your data and allows you to load your information directly into 1-2-3, VisiCalc, MultiPlan, dBase II, and many other packages, and then can convert the files back into fixed length data files (card images) to transmit back up to your mainframe. Your files can be from mainframes, commercial databases, minicomputers, other personal computers, or any application packages that create ASCII standard text files (such as word processors).

You get to preview your data, edit rows and columns with Spreadlink, and then Spreadlink automatically converts it into the right format for your application. Since Spreadlink lets you save your edit format as a command file, you can automate your reports for the next time. Spreadlink allows any mix of labels and values without any special formatting or separators. . . it also adjusts to column variations caused by stacking several dissimilar reports in one file. We use Spreadlink to move data from our Mini to our controller's PC for monthly reports. . . and it only took our controller 15 minutes to learn and start using.



Features:

- Converts standard ASCII text files to native files for Lotus 1-2-3, VisiCalc, Multiplan, dBase II, and DIF.
- Converts files from 1-2-3, VCalc, MPlan, dBaseII or any other packages that have DIF capability back into fixed format data files that can be uploaded for use by mainframe programs.
- Screen preview of your data allows you to edit out unwanted rows or columns of data. Convert only the data you need, or just take it all automatically.
- File size is only limited by the disk space available.
- No pre-editing or programming required. Reports do not need to be in columns and rows, and all occurrences of repetitive headings can be suppressed.
- Requires no installation or adaptation on the host computer end.
- Requires 128K memory, one disk drive, version 1.1, 2.x or 3.x of MS-DOS.

Applications: Download the last years financials from your IBM 3033. Using Spreadlink, load them to your 1-2-3 model for analysis to determine next years plan. Take expense figures out of a memo in a word processor text file and use it as input to your expense tracking model. Take the new data created and convert it into mainframe format. Communicate the data back up. Using your mainframe report writer, update the annual plan. All the personal computer operations are completely automated, no technical knowledge required.

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Do you ever do really important presentations? You have probably noticed that the graphics provided in spreadsheets are just not flexible or distinctive enough. Graphwriter produces the type of slides, charts, and graphs that you have seen cost thousands of dollars. It has a **built-in artist** that helps you create graphics that are boardroom quality every time. It is also extremely easy to use. This is the perfect companion to your spreadsheet!

Graphwriter is **planned for use by business.** You can tell that the authors have spoken frequently to users. The package is planned for executives or others that are not users of computers. You can use a relatively untrained person as your central graphics department, hand out the forms in the package, and service the entire organization. You can make significant changes to the style, layout, size and orientation of all the charts. The final charts may be produced in almost any size with automatic recomposition of the chart to account for the final dimensions chosen by the user. Everything is adjustable, with nothing locked in place. Yet, the pre-done formats provide a quality chart with no user intervention other than data input. You can **preview everything onscreen**, and **batch processing** is provided for output so you can setup your plotter or printer once and run many charts at a time.

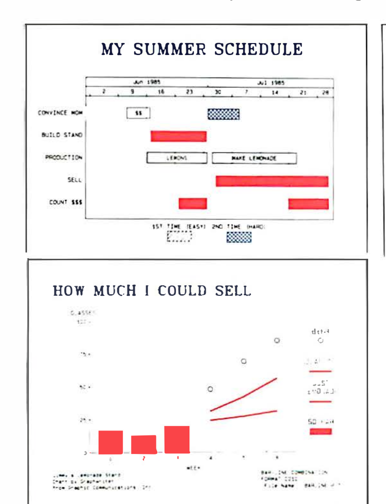
Is it hard to use? No, and you can move spreadsheet data as **DIF or SYLK files** directly in, or enter the data in the fill the blank data entry screens. **High quality output** on a wide variety of plotters and printers, **low level of effort** on your part for the input side. This is the graphics package that every organization needs. . . you know, you could set up an interesting service business with Graphwriter. We have tested them all, and this is the graphics champ.

Features:

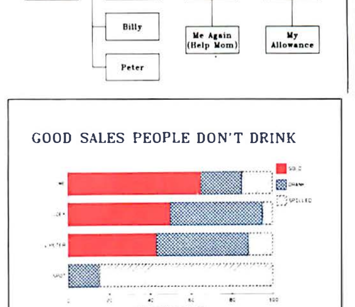
- Basic Set has 11 Formats: Column Charts; Bar Charts; Segmented Bars, vertical and horizontal; Clustered Bars, vertical and horizontal; Pie Chart with 1-4 pies on a plot; Line Charts; Scatter Plot (regression); Bar-Line Combination; Text/Word Charts.
- Extension Set has 12 Formats: Gantt Chart; Organization Chart; Bubble Chart; Table Chart; Pie-Bar Combination; Surface Line Chart; Line-Table Chart; Double Stacked Bars; Grouped Bars; Range Chart (bars); Paired Bars; Horizontal Bars with inset labels.
- Provides 8 different character fonts. Supports multiple graphs on page, fast plotting for rough drafts, totally flexible chart composition including special options for overhead projection and 35mm slides formats.
- Does pen sorting for use with plotters, allows you to use unlimited colors. With Polaroid Palette provides up to 13 colors on slide from choice of 72 colors.

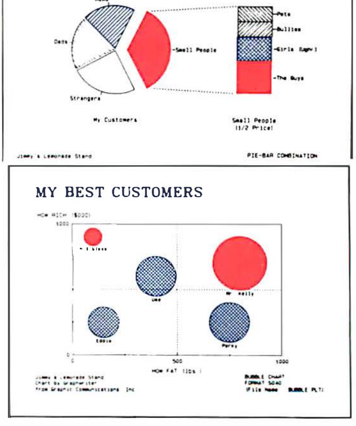
Requires: IBM PC, XT, AT, or clone with MS-DOS 2.x or above. Needs 192K (256K with Palette), 2 double-sided disk drives. Can be used with IBM monochrome monitor for plotter output only. With color/graphics board supports plotters, dot matrix printers, Palette.

Supports: **Pen Plotters**: IBM XY749; HP 7220, 7470A(opt. 001), 7475, 7550; Mansman Tally Pixy; Calcomp M84; Sweet-P™ Six-Shooter. **Polaroid Palette**: The Polaroid Palette attaches to a serial port and makes slides or prints directly. Call for more information on this accessory. **Dot Matrix Printers**: IBM Graphics printer; Epson MX, RX, FX; Okidata 82, 83, 92 and 93 w/graphic proms.



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This is a sophisticated writing tool that goes beyond simple word processing . . . we feel that this is the perfect package for offices, anyone that does heavy document preparation and assembly, or any word intensive professional. It also is a good choice for beginners in word processing, and one that you won't outgrow!

Requires: IBM PC, PCJr., XT or AT with MS-DOS 2.x or above, 192K memory, 2 drives. Full hard disk support. Networkable.

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Have a PC, want an XT? Wish you could run DOS 2.0 packages that require a hard disk? Have we found a good answer for you! The TeamMate Systems operate under DOS 2.0, install in just minutes and are **100% compatible**. . . no software drivers, no patches to the system, your PC works just like an XT. This means compatibility with all hardware peripherals and software that work with the XT. Moreover, it means that you can upgrade any PC and many IBM compatible computers to an "XT Look-alike." After you install the controller card **your PC boots from the hard disk just like an** XT (if you have an early 64K motherboard PC you will need the new ROM). TeamMate has been around since 1979 making disk controllers for computer manufacturers, and they know how to make the products right.

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The internal hard disk system is a special low-power model that really uses less power than a floppy drive. You don't need an external power supply. All the drive systems come complete, nothing else to buy. They all feature ECC assured error free storage and have the TeamMate proprietary chip set that gives unsurpassed reliability. They also are all FCC Class B approved and U.L. listed. All TeamMate products carry a 6 **month full replacement warranty**, and they will ship a swapout unit within 24 hours during the first 90 days!

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This is the **low cost alternative** to a **Winchester** disk, and it makes a **great hard disk backup.** The Kodak drive has 3.3 megabytes of unformatted storage, 2.78MB after formatting (over twice that of the AT floppy drive). It provides the ruggedness of floppy technology with the accuracy and capacity of a hard disk.

The Kodak is a half high drive, and TeamMate has provided their special **short controller card** that will fits a PC, XT or IBM Portable and **replaces your standard floppy controller.** You **can read standard 360KB IBM diskettes**, so you really get double duty from these drives. Unlike tape drives, the Kodak drive is an active direct access storage device. The units read and write twice as fast as a normal diskette. With their sturdy design, they are perfect for adverse conditions. Since you can remove the disk and carry it just like any other diskette, it fits into your existing storage systems.

There are lots of ways to use this drive. You can add a 10MB hard disk later to the external Kodak. Owing to the smaller power supply in the IBM PC, we do not recommend adding both a ½ high hard disk and the Kodak internal to a PC. It's OK to put almost any combination in an XT. You can replace the PC power supply with an XT supply if you want—call us for a price on the replacement. Our Smartware XT Kit includes everything you will need to replace your full-size floppy drive with a half-height standard floppy and the Kodak. . . probably the best of all worlds combination.

This drive carries the same **6 month warranty** as the other TeamMate products, and the Kodak logo. You know who is responsible for this one!

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(Martin Dean, Chairman of Select Information Systems)

Have you noticed all the Turkeys falling out of the sky recently? There are thousands of packages available for your personal computer, but you cannot browse through software the way you could a book. How can you be assured that those big birds aren't going to fall on you? Are you going to get the software you need, not just a "good deal"?

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Make 1-2-3 Look Like 1-2-3½

if you're a Lotus 1-2-3 user, you're already using the state of the art in business software, but if you're using a dot-matrix printer to produce your 1-2-3 graphics, you're living in the Stone-Age of computer graphics.

Produce outstanding 1-2-3 business graphics with the Roland DXY-880 8-Pen Plotter. Why is the Roland DXY-880 better than any dot-matrix printer? For the same reason a Rolls Royce is better than a pick-up truck—both will get you to the dance, but one does it with so much more style.

The Roland DXY-880 produces high-quality business graphics in eight different colors on standard 8½" x 11" or 11" x 17" paper, and draws with a lightning quickness and accuracy that can't be matched by any artist. And because the DXY-880 emulates the Hewlett-Packard graphics language, it has at its disposal hundreds of business graphics and CAD/CAM software packages.

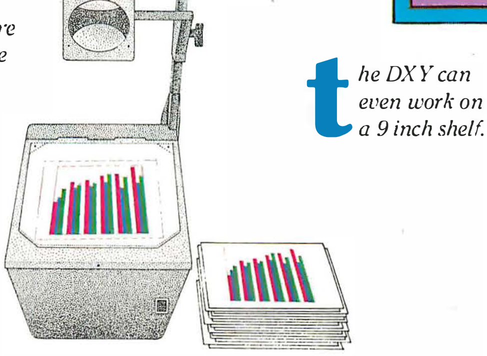
If you do a lot of group presentations, you'll like the fact you can easily produce instant overhead projection graphics just by using acetate instead of paper.

MODEL
DXY-880

Actual Lotus graph drawn by the DXY-880

123 + ROLAND DG

Lotus 1-2-3 and Roland DXY are very compatible



draw your graphics on acetate for instant projection presentation

the DXY can even work on a 9 inch shelf.

is limited desk-top space a problem? The DXY-880 also stands up to run at a 60 degree angle—perfect for a bookshelf. You can even reverse the plotting process and use the DXY-880 as an input device by activating the built-in multi-speed digitizer.

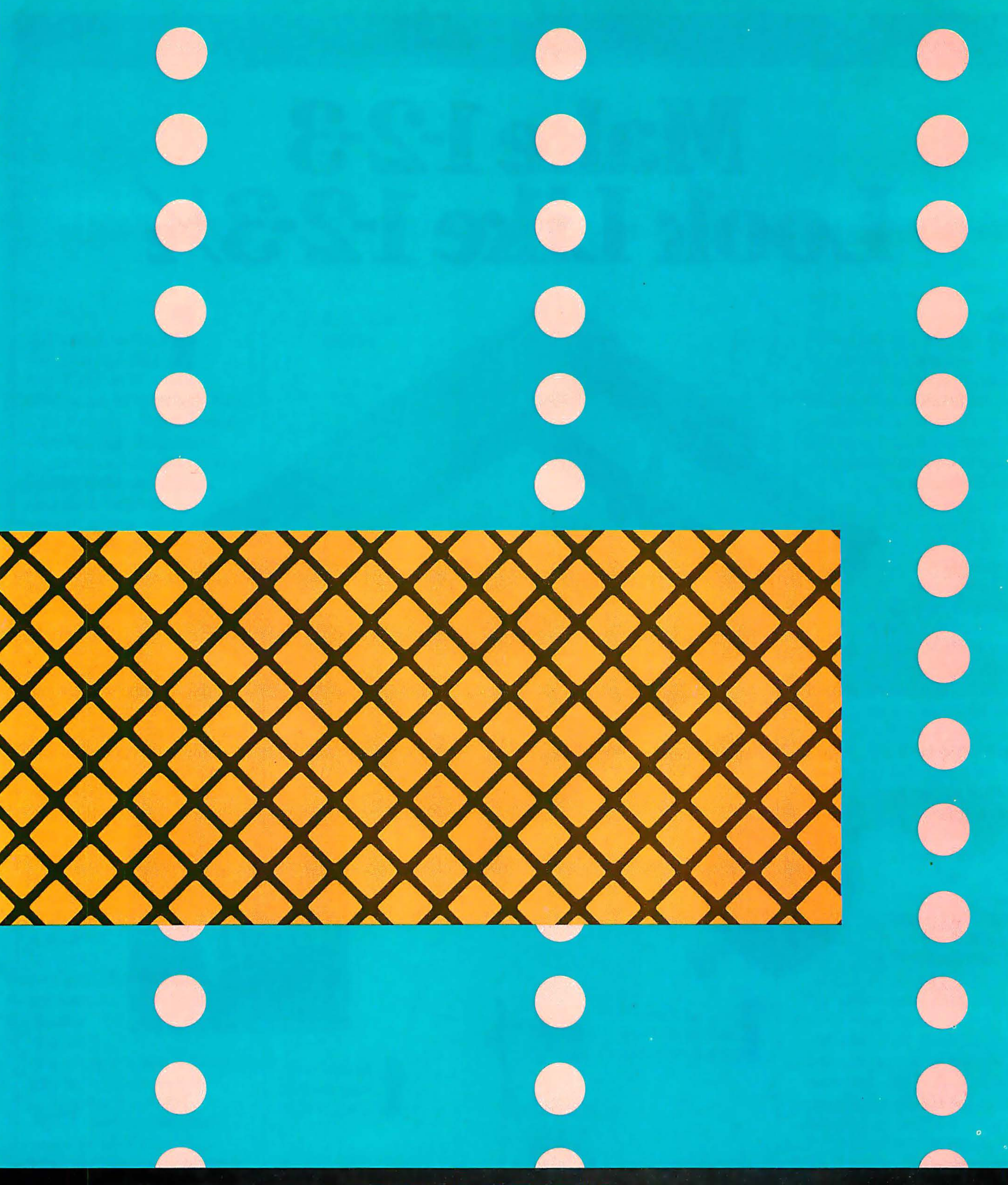
And the best part of all, is that the DXY-880 does all of this for a price that is unbelievably low ($1295.00—hundreds less than its closest competitor). How is this possible? Because the DXY-880 is from Roland DG—the new kid on the computer peripherals block (who's out to make a name for itself by packing innovation, performance, and low-price into every product).

←9→

Don't settle for 1-2-3 when you can have 1-2-3½ with a DXY-880 Plotter from Roland DG. Ask for it at fine computer dealers everywhere. Roland DG, 7200 Dominion Circle, Los Angeles, CA 90040 (213) 685 5141.

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Because when you put yourself in the place of your audience, you see that what's simple to you, isn't to them. To help people follow your thinking, you need strong, clear graphics.

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It designs, labels, and previews your chart on the screen, automatically. If you like it, plot it. If not, fix it. In seconds.

You don't have to bend over backwards to reach your audience. Reach for the software built to bring them to you. Before your next presentation, get your hands on Graphwriter at ComputerLand, Entre, or your local computer store. Or call 617-890-8778.


FORMATS
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stacked column
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horizontal bar
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clustered bar
pies (1-4)
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bar-line combination
Gantt
organization
bubble
table
pie-bar combination
surface line
stacked line
line-table
double stacked bars
range
paired bars
3D horizontal bar
FLEXIBILITY
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variable font sizes
variable font colors
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adjustable bar widths
pie rotation/placement
unequal line lengths
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A·S·K B·Y·T·E

Conducted by Steve Ciarcia

INTERFACING

Dear Steve,

I built your September 1981 speech-synthesizer project for my 6800-based self-built computer, but I can't get it to work properly. The problem is, of course, interfacing.

I connected the $\overline{\text{A}}$/R line to $\overline{\text{IRQ}}$, the STB line to R/$\overline{\text{W}}$, and the $\overline{\text{ENABLE}}$ line to $\overline{\text{BOARD SELECT}}$. On power-up, the board lets out a single phoneme and holds it. I ran my program, and the board fell silent with the computer waiting for a return from interrupt. Where have I gone wrong?

Let me fill in some details. I am using the 74121 pulse extender. The board is connected to a parallel I/O port located at 7000 hexadecimal. I know that the LM386 audio amp works and that data can be fed to the SC-01 chip. The following story illustrates that.

When I first wired the board, I connected $\overline{\text{ENABLE}}$ to GND, $\overline{\text{A}}$/R to $\overline{\text{IRQ}}$, and STB to R/$\overline{\text{W}}$. Powering up and typing on the keyboard without running my program produced a variety of sounds. Running the program silenced the board.

I thought maybe it was the STB, $\overline{\text{A}}$/R, or $\overline{\text{ENABLE}}$ line, so I rewired it so that I could try all possible combinations (for example, R/$\overline{\text{W}}$ to STB and $\overline{\text{STB}}$) but with no success. With the board wired as I mentioned at the start of my letter, I get only a "WAAA..." at power-up.

The driver program is simple. I load some text at 8000 hexadecimal. The program sets up that funny-looking ricochet reset, loads the first data byte and sends it to 7000 hexadecimal, and then waits forever with the computer silent. Running the program ends the "WAAA..." (sounds rather Zen, doesn't it?).

GARY ODOM
Tokyo, Japan

Your method of interfacing the Sweet Talker to your 6800 computer has several problems. Let's first consider the hardware.

The SC-01 chip is a "slow" device. The data lines must be held stable for at least

(continued)

Listing 1: A *driver for the speech synthesizer.*

```
                                  NAM     SPEECH
                         * UNTESTED TEXT-TO-SPEECH DRIVER
                         *
9000                              ORG     $9000
8000                     TEXT     EQU     $8000        TEXT STARTS HERE
F000                     SPEAK    EQU     $F000        PIA PORT
C000                     MDOS     EQU     $C000
9000   7F   F0   01      START    CLR     SPEAK+1
9003   86   FF                    LDA A   #$FF
9005   B7   F0   00               STA  A  SPEAK        ALL PIA BITS OUTPUT
9008   86   2E                    LDA A   #$2E
900A   B7   F0   01               STA  A  SPEAK+1      CA1 + EDGE, AUTO STROBE
900D   86   3F                    LDA A   #$3F         STOP SC-01
900F   B7   F0   00               STA  A  SPEAK
9012   CE   80   00               LDX     #TEXT
9015   7D   F0   01      NEXT     TST     SPEAK+1      BUSY?
9018   2A   FB                    BPL     NEXT
901A   A6   00                    LDA A   0, X
901C   08                         INX                  POINT TO NEXT BYTE
901D   B7   F0   00               STA  A  SPEAK
9020   B6   F0   00               LDA A   SPEAK        CLEAR PIA FLAG
9023   81   3F                    CMP A   #$3F
9025   26   EE                    BNE     NEXT         END OF STRING?
9027   7E   C0   00               JMP     MDOS
8000                              ORG     TEXT
8000   54                         FCC     'TEST STRING GOES HERE'
8015   3F                         FCB     $3F
                                  END     START
NO ERROR(S) DETECTED
LAST ASSEMBLED ADDRESS: 8015
TRANSFER ADDRESS:        9000

   SYMBOL TABLE:

MDOS     C000     NEXT     9015     SPEAK     F000     START     9000     TEXT     8000
```


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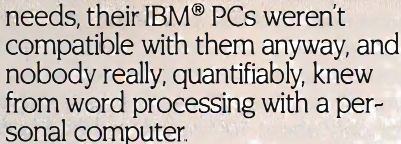
A BUREAUCRAT'S GUIDE TO WORD PROCESSING

Now, if it were you or I and we wanted a word processing program for our IBM-type PC, we'd probably stop off at our local computer store and simply diddle with a few.

You and I, however, are not the U.S. Department of Agriculture.

(Nor any of its permutations of subsystems like the Economic Research Service, National Resources Economics Division, Data Services Center, etc., etc.)

So when the USDA told ERS to tell NRED and DSC to look into a truckload of w.p. programs for all their PCs, the last thing they wanted was simple diddling. Their dedicated Wangs and Lexitrons were far too few to handle their needs, their IBM® PCs weren't compatible with them anyway, and nobody really, quantifiably, knew from word processing with a personal computer.



Definitely not a diddling-mode condition.

As they put it in The Exchange, an internally distributed publication of the Department of Agriculture: "A needs assessment showed that, in the long-term, a word processing system is needed that can increase word processing capability and also be compatible with ERS' Long Range Information Management goals."

Well. "Needs assessment" led swiftly to "procurement action," which galloped into an "objective review" of the eight top-rated PC programs on the market (as compiled by The Ratings Book published by Software Digest), along with Wordstar® and Display Write 2, because they had some around.

Thus armed with the names, the final evaluators (a team of secretaries from NRED who would be the primary users of the PC software) became armed with each of the programs, along with checklists to record such things as ease of use, advanced features, and similarity to their existing dedicated equipment.

The first to be eliminated from the prospect list were Office Writer™ and Samna,™ since they're copy-protected and couldn't be transferred to hard disks.

Next, IBM's Display Write 2: because it's "not compatible with other software used in ERS (like Lotus 1-2-3,™ dBASE II,® etc.)," and it's "full of confusing menu options and cryptic error messages." Au revoir IBM.

Then, three more, for a variety of reasons.

Which left the following:

Volkswriter® Deluxe™
MultiMate™
Leading Edge™

Volkswriter Deluxe? "Too complicated and confusing." Not "easy to learn or use."

MultiMate? Not bad. It actually tied the winner in a few categories.

The winner being the one that won 82% of the votes in the Ease of Use/Ease of Learning categories. The one about which they said, "The ability to store deleted text and automatic document backup features were both highly desirable." The one they thought they'd quickly "be able to use . . . for their day-to-day word processing tasks."

The whole process took some three months of work by people in DSC to support the NRED in its work with the ERS and DSC to make the world a better place for the USDA.

But the results were well worth the wait. Because at last they've solved their word-processing problems . . .

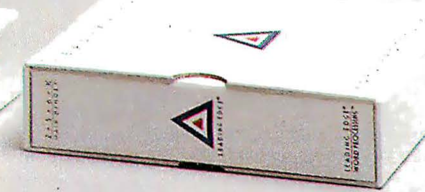
"With Leading Edge!"

THESE ARE THE PACKAGES THE COMMITTEE EVALUATED:

THESE WERE THE FINALISTS:



THIS WAS THE WINNER: LEADING EDGE™ LEADING EDGE WORD PROCESSING



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Epson RX-80F/T (100CPS)	499	299
Epson FX 80 (160CPS)	689	429
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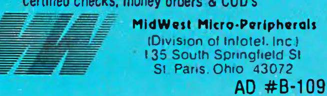
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AD #B-109

450 nanoseconds before the rising edge of the strobe. From the notes on your schematic and the lack of any port initialization in your software, I assume that you connected the data lines directly to the I/O bus lines. These lines are stable for only about 500 nanoseconds, which is too close to the minimum SC-01 setup time.

The $\overline{\text{ENABLE}}$ line, which you connected to $\overline{\text{BOARD SELECT}}$, is used only to enable the 74LS244 buffer. The SC-01 is enabled any time STB is active. In your case, this occurs on any processor write instruction.

The $\overline{\text{A}}$/R line is active as long as the SC-01 is busy. With $\overline{\text{A}}$/R connected directly to the $\overline{\text{IRQ}}$ line, a long string of interrupts will be generated for every phoneme.

All the hardware problems can be solved by connecting the Sweet Talker to a parallel port, such as on a 6821 Peripheral Interface Adapter (PIA) chip. The port will hold the data stable, toggle the STB line, enable only the $\overline{\text{BOARD SELECT}}$, and condition the $\overline{\text{A}}$/R line for interrupts.

Your method of ricochet interrupts will not work in this situation. An interrupt service routine must disable the device that holds the $\overline{\text{IRQ}}$ line low. This is not possible with the $\overline{\text{A}}$/R line connected to $\overline{\text{IRQ}}$. As soon as the RTI instruction pulls the condition code register from the stack, the processor will interrupt again (actually, it completes one instruction). Since the SC-01 holds $\overline{\text{A}}$/R low for several milliseconds, your program will be interrupted thousands of times.

If the SC-01 is buffered by a PIA, you can clear the $\overline{\text{IRQ}}$ line by reading the data register of the PIA. This will allow your RTI to return to the main program without another interrupt.

There is little need to use interrupts for the Sweet Talker. A simple test of the PIA status, followed by a branch back, if positive, is all the handshaking that is required. The printer driver in listing 1 could be adapted for your use.—Steve

Buffers

Dear Steve,

Like many other neophyte microcomputer users, I started out with a Sinclair before investing major dollars in something I might not like. The bug bit, and I'm madly computing away with a Kaypro 2 while my little old Sinclair sits in a box in the closet. Since I'm using a very slow Silver Reed 550 printer, I find myself in need of either a printer buffer or another eight hours a day. It seems to me that a genius like yourself could come up with a simple way to convert that Sinclair with its 16K-byte memory pack into a cheap printer buffer. If nothing else, maybe you could put someone on to the idea. I imagine the solution will require a reprogrammed ROM at the very least.

I'm interested in obtaining a buffer as quickly and cheaply as possible. If someone makes a couple of million dollars from this brilliant idea, please give them my name and address and ask them to send me a kit.

John C. Connell Jr.
FPO Miami, FL

It is possible to convert your Sinclair to a printer buffer, but it would not be too economical or convenient. An add-on board to create an I/O port would be required, and some software, preferably in the form of a ROM, would be needed to control it. Since this add-on board would get quite elaborate, it would be a simple matter to add a dedicated microprocessor chip, so why use the Sinclair?

A better choice would be to use one of the commercial printer buffers.—Steve

Electrical Software

Dear Steve,

I am a freelance electrical estimator. I've recently purchased a Columbia VP computer and an Okidata 92 printer and would like to use them to prepare estimates for electrical work. As yet, I have not found any software for electrical estimating. Do you know of any?

George D. Murray Sr.
Baltimore, MD

A look through the January 1984 issue of LIST revealed the following programs for electrical estimating:

Electrical Computation by
Electrol Electric Corporation
POB 157
Townsend, MA 01474
(617) 597-2708

Electrical Comp-U-Tation by
Designs IV
405 Main St., Suite 201
Worcester, MA 01608
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(continued)

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The Complete Hard Disk Solutions
For Desktop & Portable PC's 10 Megabytes $794, Or 20 Meg $1288.

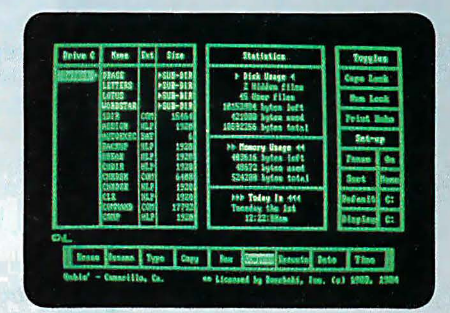
We have the whole package you need to add a hard disk to your IBM PC or compatible. Our half-height 10 and 20 megabyte drives have the lowest current draw in the industry. Unlike most aftermarket hard disks ours can "boot" direct from the hard disk. No software patches, or drivers to install just a copy of IBM PC DOS 2.0 or 2.1.

1dirfully Easy with the popular *1dir* menu driven "visual shell" software. It replaces complicated DOS commands with menus that allow you to just point at what you want to do. Help files explain DOS commands and give you on-line advice when you need it. *1dir* takes the wonder out of the tree structured subdirectories so useful in organizing a hard disk.

Hard Problems like excessive current draw and heat have until now been unsolved problems with aftermarket hard disks. Most drives draw lots of power. If your PC has many expansion boards in it, power to run a hard disk is probably not available. Hard disks have also been easily damaged by vibration and movement. And of course the problem any non-IBM product must face, compatibility with the IBM PC. We have tackled all these problems and come up with the best solutions available at any price.

Cool & In Control with half-height drives so efficient they *draw the same amount of power as a floppy disk drive.* This means a minimum of heat inside your PC with more power available for expansion boards. The controller uses LSI technology to provide fewer components, drawing less power, and giving significantly im proved performance over the IBM XT.

The Portable Plus is 10 or 20 megabytes to go. In fact, the drives we use have been selected by several computer makers for use in their portable computers. Their plated recording media helps withstand vibration, and allows the drive to be used at any angle.



Total Compatibility is a necessity. Our hard disks have the ability to boot directly from the hard disk. Check around, very few aftermarket systems can. In fact, all you need is a copy of DOS 2.0 or 2.1 and you are ready to go, no software drivers to install, or DEBUG patches to apply.

Why Buy From Us? It's simple really. Better value, and no hassles. You see, the price advertised is the whole price. No extra for freight, credit cards, COD fees, or insurance. Perhaps the best part is if you have a question you deal direct with Qubie'. We have the knowledge and ability to help you quickly. And, *if you do have a hardware problem during the warranty period it is fixed or replaced within 48 hours!*

No Risk. Don't be afraid to save. Our manual is written so even the novice can successfully install his own system. And remember, if for any reason you are not happy within 30 days of purchase you may return it for a full refund, and we'll pay the freight back! Get our competition to make the same offer, and find out which system is best. We know which one you will choose.

System Requirements: Any IBM PC with 64k RAM and PC DOS 2.0 or later. Compatible owners call for application information.

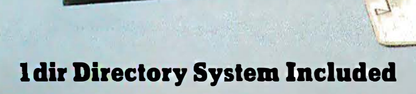
PC10: Includes 10 Megabyte drive, controller, cables, installation instructions, *1dir* software, and 1 year warranty. **$794.**

PC20: Same as above with 20 Megabyte drive. **$1288.**

Options: Auxiliary power supply, for those with computers already full of power hungry expansion boards. #PCPWR $88.

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Unfortunately, these programs operate under the CP/M operating system and are not directly compatible with your system. Write these vendors to see if a version is available for your computer.—Steve

Speech Synthesis

Dear Steve,

In your March 1984 Circuit Cellar article, "Build a Third-Generation Phonetic Speech Synthesizer," you mentioned a report by the Naval Research Laboratory. Its title was "Automatic Translation of English Text to Phonetics by Means of Letter to Sound Rules." Where can I get a copy of this report?

Mark Fortin
Boston, MA

Copies of this report may be obtained from the National Technical Information Service. The order number is AD-A021929, and the prepaid price is $13. Contact Sales Department, National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22161. Orders are usually filled in two to four weeks.—Steve

The 68000 Chip

Dear Steve,

I am a junior in high school who is very interested in computers. (I plan to make a career of it.)

I have read articles about the new MC68000 from Motorola. With high-end micros being introduced that use this chip, I am convinced that it will be one of the forerunners in the new wave of 16-bit machines.

I am interested in building a system using the 68000, but I have heard of only two available: the MC68000 Educational Computer Board from Motorola and the VU68K single-board computer kit. The one from Motorola seems to be a more complete system.

Could you please tell me about any other evaluation boards or computer kits that use the 68000 and what you think of them? I would greatly appreciate it. (Also, could a 68000-based system be configured to use the S-100 bus?)

David Foglesong
Kasilof, AK

The 68000 should be an important microprocessor chip for a number of

(continued)

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VAX HOST	CALL	COMMODORE 64
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years to come. It is now being used in several computers, including the Apple Lisa and Macintosh and the Radio Shack TRS-80 Model 16 (optionally on the Model 12). Others currently available include the Sage II, Hewlett-Packard HP 16, the Fortune 32:16, and the Wicat System 150. You can find addresses to obtain information on these in ads in BYTE and other magazines.

Interfacing the 68000 to the S-100 bus presents no special problems, except for the money involved. The easiest way to do this is probably to buy one of the 68000 S-100 boards made by CompuPro or Dual Systems Corp.

A 68000 training system is also available, the Micro 68000ECB Microcomputer Trainer from Computer System Associates Inc., 7562 Trade St., San Diego, CA 92129. I haven't seen this product, so I can't comment on it, except that the data given in the ad looks like it has features to enable you to learn to use the 68000 and to expand the system into a usable computer.—Steve ■

Between Circuit Cellar Feedback, personal questions, and Ask BYTE, I receive hundreds of letters each month. As you might have noticed, at the end of Ask BYTE I have listed my own paid staff. We answer many more letters than you see published, and it often takes a lot of research.

If you would like to share the knowledge you have on microcomputer hardware with other BYTE readers, joining the Circuit Cellar/Ask BYTE staff would give you the opportunity. We're looking for additional researchers to answer letters and gather Circuit Cellar project material.

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The Ask BYTE staff includes manager Harv Weiner and researchers Bill Curlew, Larry Bregoli, Dick Sawyer, and Jeannette Dojan.

Circle 197 on inquiry card.

NEW PRODUCT NEWS FROM TELETEK

Systemaster II. Responding to market demand for speed and increased versatility, Teletek is proud to announce the availability of the next generation in 8-bit technology — the new Systemaster II! The Systemaster II will offer two CPU options, either a Z80B running at 6 MHz or a Z80H running at 8 MHz, 128K of parity checked RAM, two RS232 serial ports with on-board drivers (no paddle boards required), two parallel ports, or optional SCSI or IEEE-488 port. The WD floppy disk controller will *simultaneously* handle 8" and 5¼" drives. A Zilog Z-80 DMA controller will provide instant communications over the bus between master and slave. Add to the DMA capability a true dedicated interrupt controller for both on-board and bus functions, and the result is unprecedented performance. Systemaster II will run under CP/M 3.0 or TurboDOS 1.3, and fully utilize the bank switching features of these operating systems.

SBC 86/87. As the name indicates, Teletek's new 16-bit slave board has an Intel 8086 CPU with an 8087 math co-processor option. This new board will provide either 128K or 512K of parity checked RAM. Two serial ports are provided with individually programmable baud rates. One Centronics-compatible parallel port is provided. When teamed up with Systemaster II under TurboDOS 1.3, this 5MHz or 8MHz multi-user, multi-processing, combination cannot be beat in speed or feature flexibility!

Teletek Z-150 MB. Teletek is the first to offer a RAM expansion board designed specifically for the Z-150/Z-160 from Zenith. The Teletek Z-150 MB is expandable from 64K to 384K. Bring your Z-150 up to its full potential by adding 320K of parity checked RAM (or your IBM PC, Columbia, Compaq, Corona, Eagle, or Seequa to their full potential). The Teletek Z-150 MB optionally provides a game port for use when your portable goes home or a clock/calendar with battery backup!

Evaluate the Systemaster II, SBC 86/87 or Teletek Z-150 MB for 30 days under Teletek's Evaluation Program. A money-back guarantee is provided if not completely satisfied! All Teletek products carry a 3-year warranty.

(Specifications subject to change without notice.)

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Things you should know about monitors

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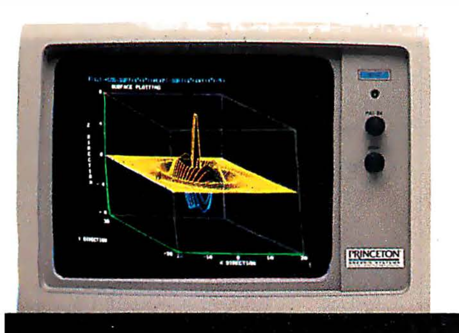
The PRINCETON SR-12 monitor features an extraordinary 640x480 (non-interlaced) resolution. The result is an extremely high quality, flickerless image with text that approaches monochrome quality. When used in conjunction with the PRINCETON Scan-Doubler card, the SR-12 runs from a standard IBM or equivalent color card, maintaining complete compatibility with all IBM software.

Dot pitch The image on an RGB color monitor is made up of a series of tiny dots. Dot pitch measures the distance between those dots. Anything finer than .38mm is considered high resolution.

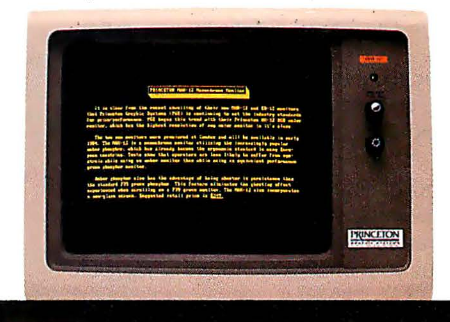
The PRINCETON HX-12 RGB color monitor, with a dot pitch of .31mm, offers the finest resolution in its class. The HX-12 delivers 16 crisp, sharp colors including clean whites without color bleed—a not-so-easy accomplishment in an RGB monitor.

Price All Princeton monitors set the price/performance standard in their class. The SR-12 at $799 compares favorably with monitors costing hundreds more. The HX-12 is in a class by itself at $695.

The PRINCETON MAX-12, with easy-on-the-eyes amber phosphor, sets the standard for monochrome monitors at $249. The MAX-12's dynamic focusing circuitry ensures sharpness not only in the center but also in the edges and corners. And it runs off the IBM PC monocard—no special card is required.







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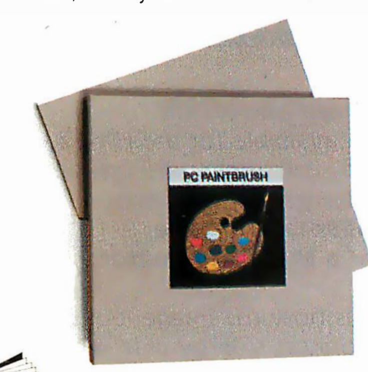
You'll be able to cut, paste, and move things around. Even enhance graphs, text, and images from other programs like Lotus 1-2-3, Wordstar, and SuperCalc 3.

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All of which makes it great for designing everything from fliers and report covers to greeting cards and birthday banners. (For a wall-sized work of art, just print sideways.)

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Then, draw your own conclusions.





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COLOR CARDS:	Amdek, Hercules, IBM, PCjr., Quadram, Scion, Tecmar.
MONITOR:	Color or black and white.
OUTPUT:	Printers: IBM/Epson graphics, Epson FX-80 and 100, MX 80 and 100, IDS Non-Color, IDS Prism Color, NEC 8023, C-Itoh 8510, Okidata 8Xor9X series, Radio Shack CGP-220, Quadram Quadjet, Transtar Color, PrintaColor TC1040, Diablo C150, Xerox 1770, Tektronix 4695. Plotter: HP 7475A.

PC Paintbrush is a registered trademark of ZSOFT CORP.

C·L·U·B·S & N·E·W·S·L·E·T·T·E·R·S

● NEW HORIZONS FOR TS USERS—*T-S Horizons* is a monthly newsletter for owners of Timex Sinclair computers. It provides programs, hardware projects, new-product news, product reviews, programming tutorials, and more. An annual subscription (12 issues) is $12, $18 in Canada, and $24 overseas. Write to *T-S Horizons*, 2002 Summit St., Portsmouth, OH 45662.

● FEEDBACK PRINTED BIMONTHLY—Entek, an engineering software and consulting firm, produces a bimonthly publication called *Enounce* to keep its customers informed. *Enounce* covers news briefs, software updates, new-product information, and product previews. It highlights products and applications, introduces Entek staff members, and prints reader feedback. For information, contact Vicki Forbes, Entek Scientific Corp., Suite 316, 4480 Lake Forest Dr., Cincinnati, OH 45242, (513) 563-7500.

● CALIFORNIA DREAMING Anyone interested in the Glendale/LaCrescenta Users Group for CP/M and Epson QX-10 owners can write to G. J. Jamriska, 2960 Hawkridge Dr., LaCrescenta, CA 91214.

● QUINCY USERS MEET The Great River Microcomputer Users Group (GRMUG) meets at 7 p.m. on the first Sunday of the month at the Quincy Computer Center in Quincy, Illinois, to discuss computers. Special-interest groups exist for games, applications, and utilities. A newsletter is produced periodically, and the club collects the $12 annual dues only as they are needed. For details, contact L. Moeller, GRMUG, 1226 Daniel Court, Quincy, IL 62301, (217) 223-5891.

● THE VALUE OF EPSON *Valnews*, "valuable news" for Epson computer users, is a nonprofit monthly publication produced by the Epson Users of San Francisco (EUSF). It previews products and provides in-depth user notes and tutorials. EUSF, also nonprofit, meets at 7 p.m. on the first Thursday of every month in the Fort Mason Center, Room C-205, San Francisco. A subscription (12 issues) is included in the $15 annual membership fee. EUSF is an official Epson America User Group. For further details, contact *Valnews*, Suite 271, 904 Irving St., San Francisco, CA 94122.

● MANY PROS IN NY Members of the MicroPro Users Group of New York (MUGNY) share information about a variety of MicroPro products. The largest possible participation is encouraged. For details, contact Jeffry Luria, MUGNY, 140 Riverside Dr., New York, NY 10024, (212) 724-5630.

● ASTRONOMICAL DISCOUNTS—People interested in computers, astronomy, and science fiction are welcome to communicate with others having similar interests. The Plutonian Society receives discounts on astronomical materials. Contact Kazys Varnelis III, POB 21, Stockbridge, MA 01262.

● QUARTERLY QUESTIONS *The Columbia User's Newsletter*, an interactive communications forum produced quarterly by Sierra Digital Research, is designed to keep owners and users of Columbia Data Products' MPC/VP series of personal computers informed of the latest news. Comments and questions from subscribers are solicited; answers are printed along with new-product announcements from CDP, system operating information, and short utility programs. Subscription rates are $5 within the U.S. and $10 abroad. For information, contact Sierra Digital Research Inc., POB 50089, Reno, NV 89513, (702) 323-3856.

● A DRILL FOR DENTISTS *Focus on Dental Computers* is a monthly newsletter that features evaluations on at least two software packages a month. It provides timely information to assist dentists in selecting and optimizing computer systems. Interviews with leaders in the computer field are included. Other professionals who may also be interested in the contents of this newsletter include financial management specialists, physicians, and computer aficionados. Subscriptions are $95 a year for 12 issues. Contact Snyder Felmeister & Co., 383 North Kings Highway, Cherry Hill, NJ 08034.

● ADAM OWNERS CLUB AND NEWS—Owners of Coleco's Adam computer can benefit from the newsletter that is produced once or twice a season to keep you up-to-date on the latest news about the Adam. Adam's Apple, the sponsoring club, provides programs, tips to improve programming, and other highlights on the computer. Address all correspondence to Adam's Apple, 4835 Edsal Rd., Cleveland, OH 44124.

● JOURNAL FOR GENEALOGISTS—*Micro-ROOTS* is a bimonthly newsletter for all levels of computerists who are interested in genealogy. It contains articles on starting a search for your family roots, reviews of genealogical software and books, activities of user groups, techniques on archival research, a query column, and a calendar of related events. A subscription is $24.95 a year. Contact *Micro-ROOTS*, Suite 32, 14208 Weeping Willow Dr., Wheaton, MD 20906.

● IBM NEWS OF TORONTO The Personal Computer Club of Toronto is a nonprofit corporation for business-people, teachers, students, professionals, hobbyists, and

(continued)

CLUBS & NEWSLETTERS *is a forum for letting BYTE readers know what is happening in the microcomputing community. Emphasis is given to electronic bulletin-board services, club-sponsored classes, community-help projects, field trips, and other activities outside of routine meetings. Of course, we will continue to list new clubs, their addresses and contact persons, and other information of interest. To list events on schedule, we must receive your information at least four months in advance. Send information to BYTE, Clubs & Newsletters,* POB 372, *Hancock,* NH 03449.



LMC's 32-bit MegaMicro provides mainframe or super-minicomputer performance at prices competitive with today's far less powerful 8- and 16-bit microcomputers. This is made possible by use of the next generation of logic chips—the National Semiconductor 16000-series. LMC MegaMicros incorporate: the NS16032 central processing unit which has true 32-bit internal logic and internal data path configured on the IEEE 796 multibus; demand-paged virtual memory implemented in hardware; and hardware 64-bit double-precision floating-point arithmetic.

The LMC MegaMicro is supplied with HCR's UNITY* which is a full implementation of UNIX** and includes the Berkeley 4.1 enhancements to take advantage of demand-paged virtual memory. Also included are C and FORTRAN. Typical multi-user systems with 33 megs. of fast (30 ms. average access time) winchester disk storage, a half meg. of RAM, virtual memory, hardware floating-point arithmetic, UNIX, C, and FORTRAN 77 are available for $20,000 (and even less with quantity or OEM discounts).

* UNITY is a Trademark of Human Computing Resources.
**UNIX is a Trademark of Bell Laboratories.

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anyone else interested in IBM Personal Computers. Members of the club produce a newsletter, maintain a software library, and meet every month to hear guest speakers. Almost a dozen special-interest groups pursue their interests. The membership fee is $30 a year. For further information, contact the Personal Computer Club of Toronto, POB 266, Station A, Toronto, Ontario M5W 1B2, Canada.

● FOR JOB HEALTH & SAFETY—Hardware, software, and procedural reviews that relate to the occupational health and safety of people in the industrial workplace is the focus of *Computers in Safety & Health*. You can receive the annual six issues for $12.50. For details, contact the publisher, Kenneth Cohen, Consulting Health Services, POB 1625, El Cajon, CA 92022, (619) 579-6233.

● SUPPORT FROM EPSON Epson America Inc. provides user-group support by offering to send the Official Epson User Group Starter Kit to Epson groups forming across the country. The Starter Kit contains a booklet with tips about how to run a successful club and outlines the services available to recognized Epson user groups, including prompt technical support from Epson and a toll-free number for EpSource, an electronic bulletin-board service. Your club can also benefit from the Techni-CALL Library, public-domain software, discounts, a speaker's forum, and national user-group conferences. Users wishing to form a group, join the network, or receive information can contact Margaret Johns or Chuck Champlin, Epson User Group Support, 2780 Lomita Blvd., Torrance, CA 90505, (213) 539-9140.

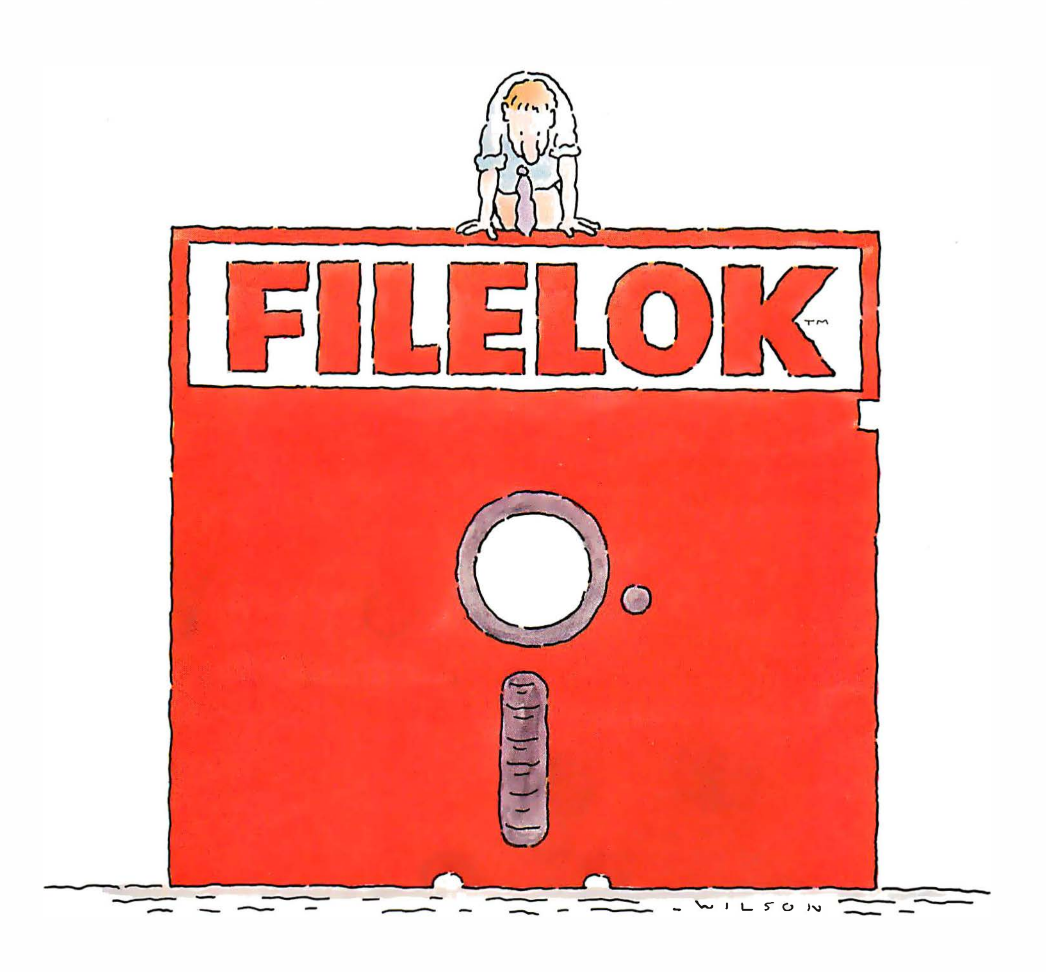
● TRILINGUAL GREETINGS The Global Computer Club (GCC) serves users in the European community by exchanging information through *Handshake*, a bimonthly journal produced in English, French, and German. The £12 annual membership fee entitles you to receive the journal, which contains a swap shop, a contacts column, a computer update, information on postgraduate teaching series, and a robotics tutor. Contact Alphonse Boehm, Global Computer Club, 51 Applegarth Dr., Ilford, Essex IG2 7TQ, England.

● FIRST FOR THE 16s The Micro 16s Users Group for Fujitsu owners meets in the Los Angeles metropolitan area to share experiences, exchange information, listen to speakers, and witness demonstrations. A newsletter contains meeting times and locations, minutes of the last meeting, and the outline for future ones. For details, contact William H. Mestler, 4615 Ellenita Ave., Tarzana, CA 91356, (818) 881-1288.

● DILIGENT PUBLIC DOMAIN IN NC—The Capitol Area CP/M Users Group (CACP/MUG) maintains an extensive public-domain software library for its members. The focus is on CP/M-80, CP/M-86, and MP/M II. The group operates two RBBS/RCPM systems, and a newsletter is in the works. Meetings take place at 7 p.m. on the second Thursday of every month in the Dreyfus Auditorium at Research Triangle Park, Raleigh, North Carolina. The $15 annual membership fee entitles members to library access and the RCPM. Interested persons can send a self-addressed, stamped envelope to Bill Weinel, CACP/MUG, 139 Pineland Circle, Raleigh, NC 27606. ■

 Circle 233 on inquiry card.

THE SNOOP-PROOF DISK.



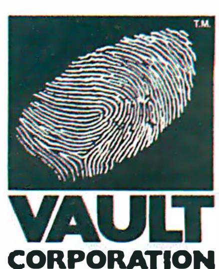
Vault Corporation, producer of the advanced Prolok™ and Telelok™ security disk technology, introduces Filelok,™ the inexpensive, effective means of protecting confidential data files from unauthorized access and duplication. Now you can instantly protect all kinds of sensitive information, including word processing, spread sheets and graphics, as easily as saving a file.

Filelok data security disks provide file-by-file security selection, protected back-up copies, optional passwords, and hard disk compatibility. It works with virtually all PC®/MS-DOS® software, including the popular Lotus® 1-2-3,® dBase II® and III,® and WordStar.® All this comes on a U.S.-made 5¼-inch, double side/double density disk of the highest quality. With reinforced hub and lifetime warranty. Certified 100% error-free. The same kind of high performance disks you require every working day with one important difference—they're protected.

Filelok's genius is its simplicity of use coupled with an extremely high level of protection. It looks like an unprotected disk and works like an unprotected disk. Simply tell the computer which file(s) to protect and on which disk drive they're located. Instructions can be as simple as B:FL A:(applications software).

Filelok eliminates the need for expensive add-on hardware. All the technology is on the disk itself. Filelok disks are marked with unique physical "fingerprints." And no two are alike. A precise description of the print is encoded on each disk. Prints and descriptions are compared whenever a protected file is accessed and an *exact* match must occur before any decrypted data is released. Protected back-ups are easily made. However, to read them the original Filelok disk must be present in the system. Unauthorized copies having a different or non-existent fingerprint yield only encrypted—and useless—data.

For the Filelok dealer nearest you, call 1-800-445-0193. In California, call 1-800-821-8638. We're adding dealers as quickly as possible but if you can't find one nearby, simply call either of the numbers above. Or write Vault Corporation, 2649 Townsgate Road, Suite 500, Westlake Village, CA 91361. And do it now. Because some people are more nosy than you think.



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In the 1 hour, 4 minutes other streamers take, you could call your broker. Linger over coffee. Wade through the Wall Street Journal. And read this PC Megastore™ ad too. So take the time. You'll more than make it up with a PC Megastore hard disk and tape hooked to your IBM-PC* or compatible, Apple II or IIe,† because all the files you need–both current and archive–will always be right where you need them. Just a keystroke away. The secret? Only Ampex backs up a 20 MB hard disk with another 25 megabytes* of addressable storage–a unique, bootable streamer with cache memory. That not only means you can address a file in 92 seconds, you can backup files offline just by touching a couple of buttons. Without tying up your computer. Your time. Or a small fortune in floppies. (In fact, our 45 megabytes of available storage cost about half the price per MB of other hard disks.) So consider your time, money and convenience. And our quality. The PC Megastore system is backed by a full year warranty from Ampex, a company known for manufacturing quality computer peripherals for over 20 years. Take a moment. Call 800 421-6863, or 213 640-0150 in California. Or write: Ampex Computer Products Division, 200 N. Nash St. MS M-11, El Segundo, CA 90215. We'll give you a dealer's name so you can buy a PC Megastore system. Then in no time at all, you'll make up for the 92 seconds you spent reading this ad.

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*PC Megastore is upgradeable and comes in four models: 20 MB with 25 MB tape, 10 or 20 MB disk, or 25 MB tape.

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A review of the IBM Personal Computer Family. Vol. 1, No. 2



HARDWARE NEWS

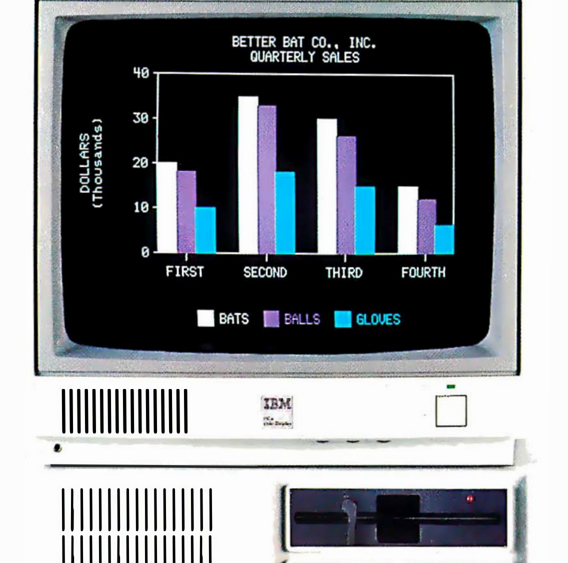
Progress. Even for a youngster with unusual potential, the IBM PC*jr* has made a lot of progress in its first year.

Consider memory for example. The IBM PC*jr* comes with up to 128KB of internal user memory. You can also add external memory expansion units of 128KB each, up to a total of 512KB. That's far more potential memory than other computers of its price range and weight class (10 pounds).*

Increased memory allows you to take full advantage of the IBM PC*jr*'s powerful 16-bit processor. With up to 512KB of available memory and PC*jr*'s double-sided diskette drive, you can run thousands of best-selling programs that have been developed for the IBM PC. If you're a programmer, the PC*jr* joins the other members of the IBM PC Family as a full-fledged application development tool.

There is also a variety of plug-in cartridge programs, which work faster than diskettes and don't take up any user memory. Three popular examples are Lotus 1-2-3™, PC*jr* ColorPaint, and Managing Your Money™ by financial expert Andrew Tobias. And every PC*jr* comes with cassette BASIC built into the system board.

PC*jr* makes it easy and affordable to start small and grow at your own pace. The $599 PC*jr* Entry Model, for example, comes with 64KB of memory, runs cartridge programs, and can easily be expanded into a diskette model. The PC*jr* Enhanced Model at $999** offers 128KB of memory—enough to run many programs from the IBM PC software library—and a 360KB diskette drive.





Cartridge-based programs for PCjr include Lotus 1-2-3™.

No matter which model you choose, the IBM PC*jr*'s 13 ports for plug-in options make it easy to add to your system, from more memory, to a modem, joysticks (PC*jr* can accommodate two), color monitor, or other peripherals.

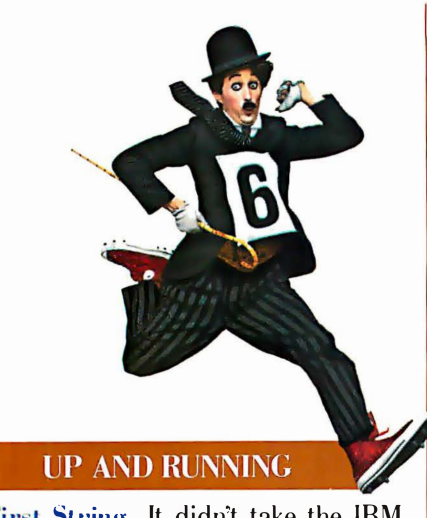
Keys and colors. The IBM PC*jr* now comes with a new typewriter-style cordless keyboard that frees you to work up close or across the room from the system unit.

While PC*jr* can be connected to just about any display, including your TV set, the IBM PC*jr* Color Display offers some real advantages at a very reasonable price.

It has a built-in speaker and an earphone jack for educational and entertainment programs that feature music and sound effects. The non-glare RGB screen gives you better character definition and clarity than a color composite monitor. And since the PC*jr* Color Display is designed to be placed on top of the system unit, it's a space-saving addition to your PC*jr* system.

Whatever monitor you decide to add to your PC*jr* system, there's no extra expense for an additional interface card. Ports for both monitors and serial printers are built in.

*Weight does not include power pack and monitor.
**Prices shown apply at IBM Product Centers.
Lotus 1-2-3 is a trademark of Lotus Development Corporation.
Managing Your Money is a trademark of MECA.



UP AND RUNNING

First String. It didn't take the IBM PC*jr* long to make the team. In its first year of eligibility, PC*jr* was picked by coach Grant Teaff to play a key position for the Baylor University football team.

Coach Teaff has a practiced eye for players with potential. He's coached the Baylor Bears to two Southwest Conference championships, been named Southwest Conference Coach of the Year five times, and was National Coach of the Year in 1975.

The Bears' coaching staff has used computers to help analyze scouting reports and playing patterns of opposing teams for nearly ten years. In the beginning, though, there was a lot of competition for a limited amount of computer time.

Coach Teaff and his assistant coaches had to write up all their game and player information and then have it keypunched. After that came a wait for processing time on Baylor University's mainframe computers, time that had to be shared with other departments and the university administration. Analysis of a game often wasn't available until a week after it had been played.

PC*jr* helped change all that.

Winning Tendencies. Coach Teaff calls the IBM PC*jr* "the ideal football coaching tool." With up to 512KB of available memory, it's powerful enough to make his staff independent of the University's central computers. And PC*jr* and the PC*jr* Color Display are inexpensive and compact enough to be used in offensive and defensive staff meeting rooms.

Using software developed by Coach Teaff, PC*jr* enables the Bears' coaches to enter information as they view game film of an opposing team and to see results immediately. When play-by-play statistics of several games are compiled and analyzed on PC*jr*, the coaches are able to identify tendencies of a team in given situations. They're then able to adjust their own game plan accordingly.

When Baylor plays new opponents, for instance, the two teams exchange films of past games. PC*jr* is used to analyze variables such as down, distance, and type of play. The Baylor coaches enter the game with much the same level of knowledge as if they'd played the new team for years.

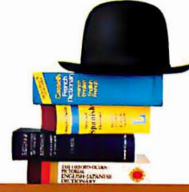
The IBM PC*jr* helps out with other coaching duties as well. Team statistics, information about possible recruits, and numerous business and financial chores are all part of its workload.

Other coaches around the country had a chance to see the benefits of computerized coaching techniques this summer when members of the Baylor coaching staff demonstrated their programs at the nationwide football and basketball clinics sponsored by The Coaches, Inc.

Coach Teaff points out that a PC*jr* could make the difference between winning and losing to teams—small high schools, for example—with a limited budget and coaching staff. Using the PC*jr*, he says, "is like adding two or three men to the staff."

Not bad for a 10-pound, first-year player.

PCjr is a team player for Coach Grant Teaff.



WHAT'S THE PROGRAM?

Maximum Security. Some information belongs under lock and key. But the rapid growth of personal computing and computer networks makes it increasingly difficult to keep it there.

Data Encoder software from IBM can help ensure that sensitive information—personnel and payroll records, for instance—is available only to those with a need to know. It uses the Data Encryption Algorithm developed by IBM—and adopted as a U.S. Government Standard—to encode and decode IBM Personal Computer data files and programs.

You don't have to be a master cryptographer to use Data Encoder. For members of the IBM Personal Computer Family with 192KB of memory, there's a full screen interface with menus and help screens. Systems with 128KB use easy

DOS-like commands. You designate the key that triggers encoding and decoding procedures.

Files protected by Data Encoder can still be sent through IBM Personal Communications Manager or any other communications program with a text transparency feature. Without Data Encoder software and the proper security key, however, the information remains unintelligible.

So much for prying eyes.

In the clear. While some people are determined to keep things confidential, others want nothing less than perfect clarity. The following new members of IBM's growing family of programming productivity tools can help remove that unwanted element of mystery from your application programs.

The IBM Professional Debug Facility can help make short work of improving your assembler language programs. It includes a Resident Debug Tool for full function, full screen interactive debugging, a Disk Repair Program, and a Non-maskable Interrupt card for access to a system that's locked because of program error.

The IBM Personal Computer Application Display Management System (ADMS) simplifies creation of clear, informative screens for application programs. Since screen development is one of the most time-consuming programming tasks, ADMS can help dramatically increase your application development efficiency and productivity.

ADMS consists of two parts. The Application Display Designer is a screen building program that significantly reduces the program coding required for an application. The Application Display Manager is a run-time program that interprets the screen design code.

Screens defined with ADMS remain independent of the application program, so they can be modified or redefined without affecting the logic of the application.

The view from the top. It's worth noting that programs developed with the help of ADMS can run under TopView, IBM's new multitasking operating environment.

TopView's multitasking capabilities allow you to work quickly and efficiently with a wide range of application programs. You can switch rapidly from one program to another without reloading diskettes and can copy information from one application to another. Sales figures from a spreadsheet program and a document from a word processing program, for example, can be used concurrently to produce a sales report combining financial information and text.

In addition, the TopView operating environment supports advanced windowing facilities, data transfer among different applications, and pointing devices such as a mouse. All are features that enable you to work easily with a variety of applications.

Data Encoder software from IBM.

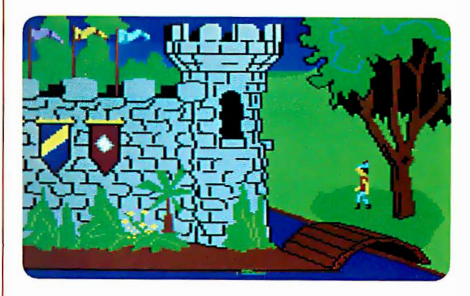
There's also an IBM TopView Programmer's Toolkit available that contains the routines, utilities, and systems related information necessary to develop applications that run under TopView.



FUN AND GAMES

Medieval adventures. The ideal game is easier to define than to find: it should be entertaining *and* enlightening. There are new programs from IBM that manage wonderfully to be both.

King's Quest from IBM, for example, is chiefly for fun but does impart a few important lessons. The hero of this colorful three-dimensional adventure game, the valiant Sir Grahame, is sent by the King of Daventry to search the countryside for three magical items that will prevent the kingdom's collapse. Along the way, he encounters dangerous creatures, makes new friends, and avoids—or tries to avoid—treacherous terrain.



King's Quest software from IBM.

King's Quest is unusually enjoyable because you interactively control Sir Grahame's wanderings, helping him duck, jump, or swim his way through the quest. Many tasks can be solved in different ways, and more creative solutions are awarded higher scores.

Hence also the educational value. Cleverness and imagination are rewarded. And a few valuable practical lessons are reinforced along the way. Looking, for instance, before one leaps into alligator-filled moats and deep, dark holes.

King's Quest runs on the IBM PC*jr* and makes good use of some special PC*jr* capabilities. Sir Grahame's movements, for example, are unusually smooth and realistic because multiple video buffers in main memory are used instead of a single chip to create the animation effects. PC*jr*'s three voice sound creates an impressive variety of sound effects, such as a fanfare of horns when the castle door opens. And PC*jr*'s ability to produce 16 colors lends a touch of realism to an imaginary kingdom.

Modern machines. But can a program with more serious didactic intent be as enticing as Sir Grahame's rough and tumble lessons? Yes, if it's Rocky's Boots™, winner of *Learning* magazine's Software of the Year award and of high praise from *The New York Times.*

In fact, Rocky's Boots from IBM is also a quest for creative solutions to a series of different games. Along the way, both children and adults can learn the basics of electronic circuitry and of the Boolean logic that drives computer operations.

Lest that sound too intimidating, remember that the learning is a by-product of games in which you build various simulated machines on your display screen. Early sections of Rocky's Boots guide you through basic instructions about building and activating simple electronic devices.

You're also introduced to the various "spare parts" and "tools"—such as clackers, boppers, alligators, and alligator detectors—that may come in handy. Later in the program there are more challenging games to play using the machines you've built.

All in all, Rocky's Boots is as thoroughly engrossing as King's Quest. And on one point, at least, it's easier: Sir Grahame has to make do without an alligator detector.

Christmas cheer. Rocky's Boots and King's Quest are part of a special Christmas collection of entertainment and educational software from IBM.

Some others in the Christmas collection come from the same series of IBM learning games as Rocky's Boots. They include Bumble Games™, Bumble Plot™, Gertrude's Puzzles™, Gertrude's Secrets™, and Juggles' Butterfly™. See your authorized IBM Personal Computer dealer, IBM Software dealer, or IBM Product Center for complete details.

The Learning Company reserves all rights in the Juggles, Bumble, Gertrude, and Rocky characters and their names as a trademark and under copyright law.
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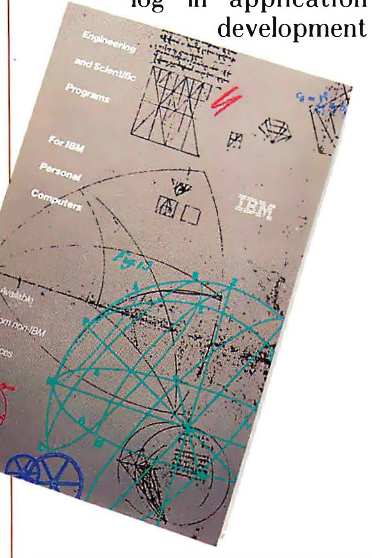


HARDCOPY

Full Disclosure. If business applications or entertainment programs aren't what you're after, there's a new software listing available from IBM, one with a long title but a specific purpose: the directory of *Engineering and Scientific Programs for IBM Personal Computers Available from Non-IBM Sources.**

It lists programs in a wide variety of engineering/scientific categories, from Computer Graphics to Lab Automation and Statistical Techniques. The *Engineering and Scientific* directory includes program descriptions, minimum configuration requirements, initial availability dates, and vendor information.

If your department or laboratory is suffering a backlog in application development



Directory of engineering and scientific programs for IBM Personal Computers.

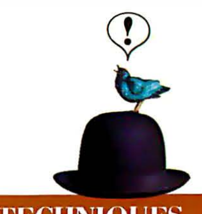
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work, one of these programs—in original form or with a little modification—may be the answer.

For information about where to get the IBM *Engineering and Scientific* directory, see the box at the end of this issue of *Read Only.*

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*IBM has not evaluated these programs and makes no comment, warranty, or guarantee as to their functions, quality, or performance.



TIPS AND TECHNIQUES

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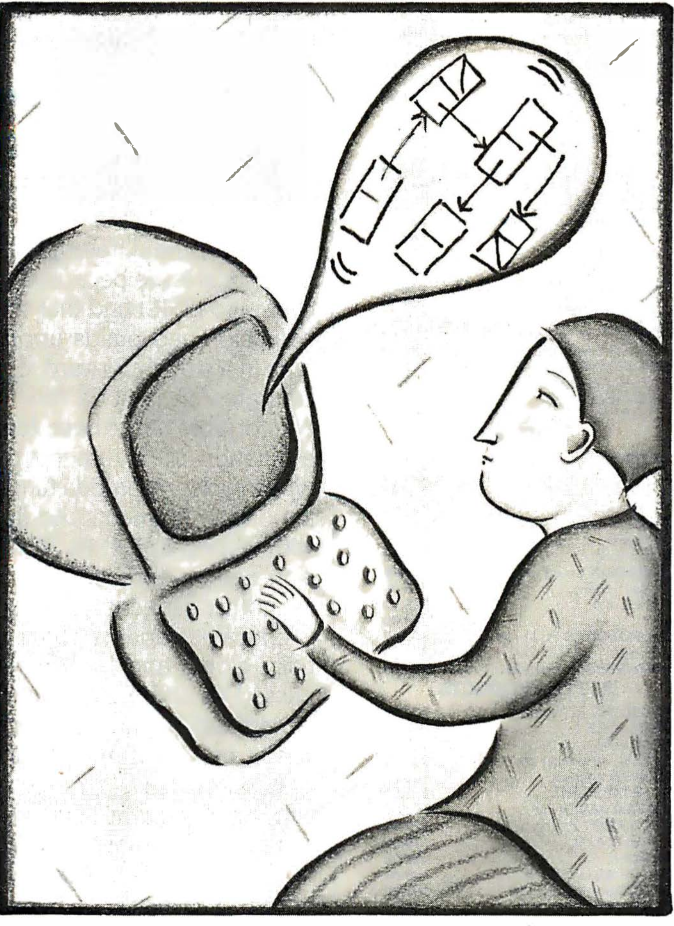
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LISPcraft
Robert Wilensky
W. W. Norton
New York: 1984
384 pages, $19.95

Talking Computers and Telecommunications
John A. Kuecken
Van Nostrand Reinhold
New York: 1983
256 pages, $26.50

Assembly Language Primer for the IBM PC & XT
Robert Lafore
New American Library
New York: 1984
501 pages, $21.75

Computer Ethics: A Guide for the New Age
Douglas W. Johnson
Brethren Press
Elgin, IL: 1984
120 pages, $6.95



LISPcraft

Reviewed by Jerry Smith

A variety of software products available recently make use of programming techniques that originated in the field of artificial intelligence (AI). Examples are database systems that can process simple English queries and packages for solving systems of equations. These products are indicative of an increasing acceptance of the developments in AI. As a result, we may expect an increased interest in the tools and techniques of this discipline. One of the oldest tools used by AI researchers is LISP, a list-processing language. Several LISP interpreters are available for microcomputers.

LISP as a programming language is quite different from sequentially rigid, procedural languages, such as PL/I and FORTRAN. With these procedural languages you are always aware of and confronted with the computer's basic architecture, much like programming in assembly language. LISP, on the other hand, provides you with a higher-level data structure, the list, which becomes the programmer's basic building block. In writing a text for such a language, it would be easy to introduce LISP via a comparison with the more primitive languages already mentioned. Fortunately, Robert Wilensky in *LISPcraft* avoids this approach from the very beginning, rarely making comparisons with other languages.

Wilensky begins with a discussion of the basic expressions in LISP in terms of arguments and commonly used functions. He uses this opportunity to acquaint the reader with LISP's approach to expression evaluation. While the author appropriately avoids comparison of LISP to other languages, he seems aware of the likelihood that the reader will make such an association.

The evaluative, functional nature of LISP is very conducive to interactive programming. Wilensky uses this feature of LISP to its full potential by illustrating each new feature of LISP with a sample interaction. The reader is thus an active participant in spirit, if not in fact. While reading the text I was logged on to my computer, actively following the examples. In addition to the immediate feedback you get, this encourages the noting and documenting of differences between your version of LISP and that used by the author.

With LISP there is no accepted language standard. The dialect of LISP used in this text is FranzLISP. Lack of a standard for a language often makes choosing and reading a text a less than pleasant experience. (I have found this to be the case with several Pascal texts.) Wilensky de-emphasizes this in two ways. First, he concentrates on the basics. Only after developing the central idea of a feature

(continued)

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does he pay particular attention to the specifics of FranzLISP. This approach is beneficial to users and non-users of this LISP dialect. Second, for the benefit of FranzLISP users, the author provides in later chapters specifics of and enhancements due to this dialect. By this time, users of other dialects are not distracted and FranzLISP users obtain useful information. This approach also facilitates the use of the text as a reference manual.

There are two cases in which the nonstandard nature of LISP is readily apparent—debugging and error handling. These are concerns with any book about a programming language. Wilensky handles them in separate chapters. He has divided his material into relatively small, focused chapters and follows each chapter with concise summaries and exercises.

I remember first studying LISP and being somewhat confused over the different types of functions available. This is a critical issue because functions and function calls are central to LISP. I find that this text almost anticipates such confusion and builds upon each discussion of function type in a straightforward, comparative way. Wilensky concentrates on lambda functions first. After the reader is comfortable with these functions, which always lead to evaluation of arguments, the author introduces other types, such as nlambda functions, which do not cause evaluation of arguments. Additionally, he explains functions with respect to EXPRs, FEXPRs, and LEXPRs. The discussion here is excellent.

Another aspect of LISP for which a clear understanding is critical is variable scoping. LISP uses what are essentially global and local variables. Variables that are not passed as arguments, but that exist outside of and are referenced by functions, may have their values change. These are called free variables. Since LISP programs execute interpretively, potentially calling any LISP function already defined, it is impossible to determine the limits or ramifications of free variable referencing until execution time. This is frequently termed dynamic scoping, as opposed to lexical scoping in languages such as PL/I, in which you can determine a variable's scope by context.

A final aspect of LISP that is critical in any text is LISP internals. Wilensky discusses the binary-tree approach used by LISP for storing lists and the way in which LISP manages its symbol table.

Another aspect of LISP that the author covers nicely is recursion, the process whereby a function calls itself. The discussion is complete and supplemented with diagrams, important for users who are accustomed to languages that do not let you use recursion. Wilensky also covers iteration, for those who prefer this approach to recursion. He gives examples contrasting these totally different approaches to implementing repetition in a program with consideration for the advantages of each approach. Conditional testing and logical operators are handled in an early chapter, with these features being used frequently in subsequent examples.

Although the chapter on reading and printing is essen-

tially complete, I would have appreciated more examples. However, I also recognize that input/output is implementation-specific.

Earlier I mentioned the possibility that programmers new to LISP could be adversely affected by prior knowledge of dissimilar languages. A tendency to structure LISP programs like those written in other languages is harmful to the extent that you may not make the most of those features inherent in LISP. Wilensky addresses this issue with two chapters on LISP applications. This gives the reader/programmer a flavor for LISP and the power inherent in its list-processing approach.

LISPcraft addresses the critical issues well, as should any text. However, it is the organization and method of presentation that makes it such a good text and reference.

Jerry Smith (1500 Layton Lane, Signal Mountain, TN 37377) is an assistant professor of computer science at the University of Tennessee-Chattanooga with research interests in database and knowledge-based systems.

TALKING COMPUTERS AND TELECOMMUNICATIONS

Reviewed by Michael O'Neill

The title of this book and the description on the dust jacket are misleading. I got the impression that *Talking Computers and Telecommunications* might be an introductory survey of the whole range of computer applications in telecommunications and was concerned with the social forces that formed this technology, as well as the technology itself. In fact, *Talking Computers* is not a survey, does not cover a wide range of topics, and is not especially concerned with the origins of the technology it does deal with.

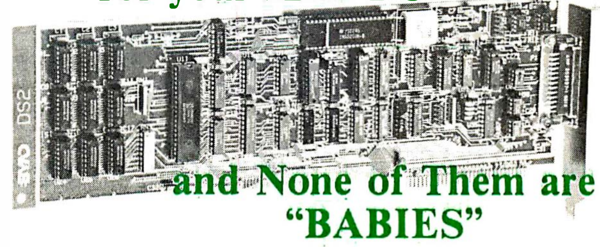
The book is actually a discussion of the technical aspects of two specific topics. The first part of the book deals with design considerations for equipment to automatically dial and answer telephones. This section details the various control signals used by the phone system and describes what sort of circuitry is needed for recognition and generation of those signals.

The second part describes some of the equipment available for the computer-controlled electronic generation of speech. The author treats, in great detail, Moser encoding (used by National Semiconductor) and linear predictive coding (used by Texas Instruments). He also includes material on the production and characteristics of natural speech and a chapter on the digitization of speech waveforms. A final chapter gives an introduction to and evaluation of work in automatic speech recognition. Except insofar as telephone-quality speech reproduction is considered a standard for speech generation, there is no connection between the two parts of this book.

This is not a how-to book; it is a how-to-go-about-it book. You will not find fully elaborated designs here. Instead, the author provides general guidelines and presumes that

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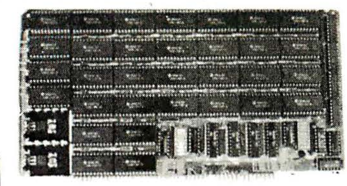
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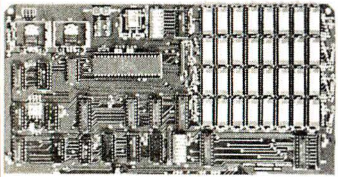
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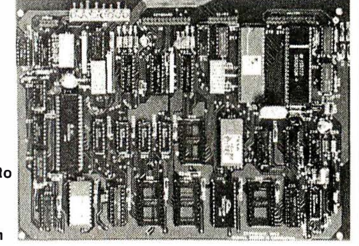
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you have enough knowledge of hardware and software to choose the method best suited to your needs. Kuecken includes a number of circuit diagrams and BASIC computer programs, but these are used more to illustrate principles than to exemplify practical systems.

The author has evidently had extensive experience designing the types of systems he discusses. He offers much practical advice about such matters as how well you can expect real telephone signals to conform to published standards and how well you can expect speech-synthesis systems to perform.

A minor problem with this book is the author's tendency to include more information than is really necessary. This is particularly noticeable in his discussion of the Texas Instruments speech-synthesis chip; he gives a more extensive presentation of the internal workings of this chip than is really needed to apply it, and the applications information gets buried in all this detail. In the chapters on sound and speech and their generation, the author lets his interest in music carry him away. He includes a good deal of information that is not relevant to the subject of speech generation. Although I share Kuecken's interest in music and I think that his use of a musical perspective is a good way to introduce the subject of sound, his inclusion of irrelevant and speculative material will confuse many readers. (One practice of the author's that I would be glad to see used elsewhere is his inclusion of musical-note equivalents of frequencies. These help to clarify the relations between various frequencies.)

I have noticed two errors of fact in *Talking Computers*. The first one occurs when the author describes the production of musical waveforms using the Fourier transform, i.e., by adding together sine waves of various frequencies. So far, so good. He then claims, incorrectly, that this is similar to the operation of a Moog synthesizer. (The Moog machine works by filtering a complex waveform; see reference 1.) That error is not especially important. The second error is, Kuecken claims that the fast Fourier transform requires about 2N operations; it actually requires a number of multiplications proportional to NlogN (N is the length of the sequence to be transformed; see reference 2). This may be a typographical error; still, the text is wrong.

Kuecken has written an eminently readable book. Those who are interested in the topics covered by *Talking Computers and Telecommunications* should find it useful. I hope that the misleading dust-jacket copy does not prevent it from reaching its proper audience.

REFERENCES

1. Moog, R. A. "A Brief Introduction to Electronic Music Synthesizers." BYTE, December 1982, page 278.
2. Brigham, E. O. *The Fast Fourier Transform*. Englewood Cliffs, NJ: Prentice-Hall, 1974, page 8.

Michael O'Neill (2227 Dwight Way #4, Berkeley, CA 94704) has been a programmer for 20 years.

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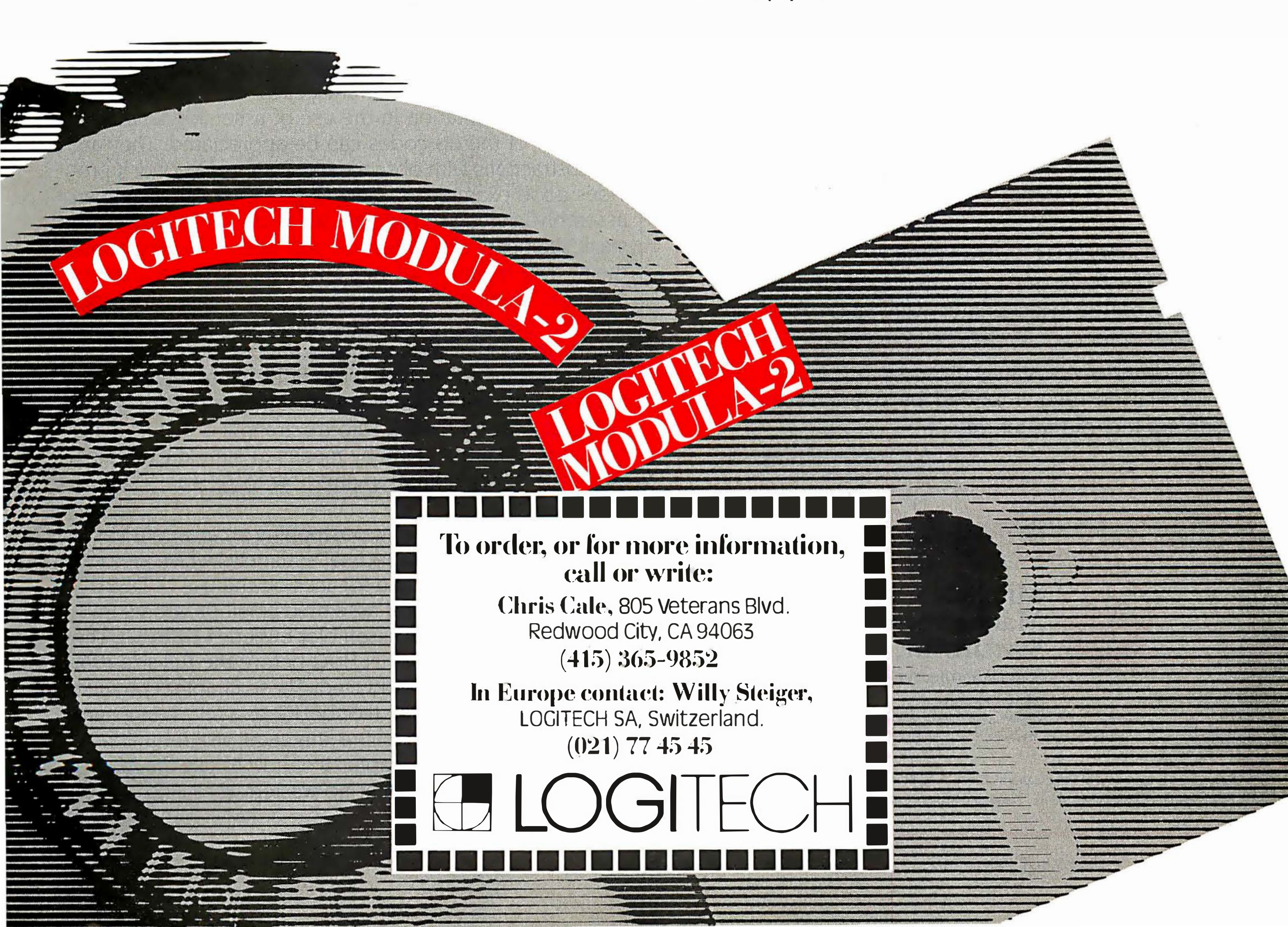
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ASSEMBLY LANGUAGE PRIMER FOR THE IBM PC & XT

Reviewed by John Figueras

Anyone who is new to assembly-language programming on the IBM Personal Computer (PC) and feels completely at sea will find a welcome port in Robert Lafore's *Assembly Language Primer for the IBM PC & XT.*

The problem for beginners in 8088 assembly language is twofold. There is, of course, the language itself, with its several peculiar ways of addressing memory, its hundreds of mnemonics, and the question of how to apply the operations to solve a given problem. But beyond this is the problem that assembly-language programs must run in a specific operating environment. A knowledge of the language alone might enable a person to write a program to add two numbers, but how is the answer to be displayed? This is why abstract presentations of assembly language based solely on chip architecture (such as the highly recommended *The 8086 Book* by Russell Rector and George Alexy, Berkeley, CA: Osborne/McGraw-Hill, 1980) are poor beginning texts, although they are of great value to the experienced programmer who wishes to find succinct descriptions of commands without wading through a lot of exposition.

Lafore recognizes the beginner's plight and has written a book that teaches assembly language within the context of the IBM (MS-DOS) operating system and not as an abstract expression of the properties of a microchip. The approach has many advantages for the beginner. First, it provides orientation in the use of assembly language: the utility of the op codes can be appreciated. They are not abstractions with obscure applications. Second, it provides good examples of how to go about organizing an assembly-language program. What do code, data, and stack segments do? When do you need to worry about them? The meaning of the questions and the answers becomes eminently clear when you encounter the problems of space conflicts within large, unsegmented programs. This topic leads naturally into the concept of the address segment, which is a rather bewildering notion to beginners. Lafore makes it easy to understand, for which he has at least my thanks. Lafore's strength is that he leads the reader to appreciate, by means of simple examples, the virtue of segmentation and how to go about setting it up in a program.

The author starts gently, postponing arcane considerations of binary and hexadecimal arithmetic, which are confined to Appendix A, and focuses on the use of DEBUG to examine memory and assemble small programs (MS-DOS 2.0 contains a miniassembler buried in DEBUG). The first four chapters cover DEBUG before the full-size IBM Macro Assembler is introduced. These chapters provide an excellent introduction to DEBUG, as well as exposure to the rudiments of machine-language programming.

The explanations in chapter 5 of how to use the Macro Assembler are outstanding: no wasted words, no confu-

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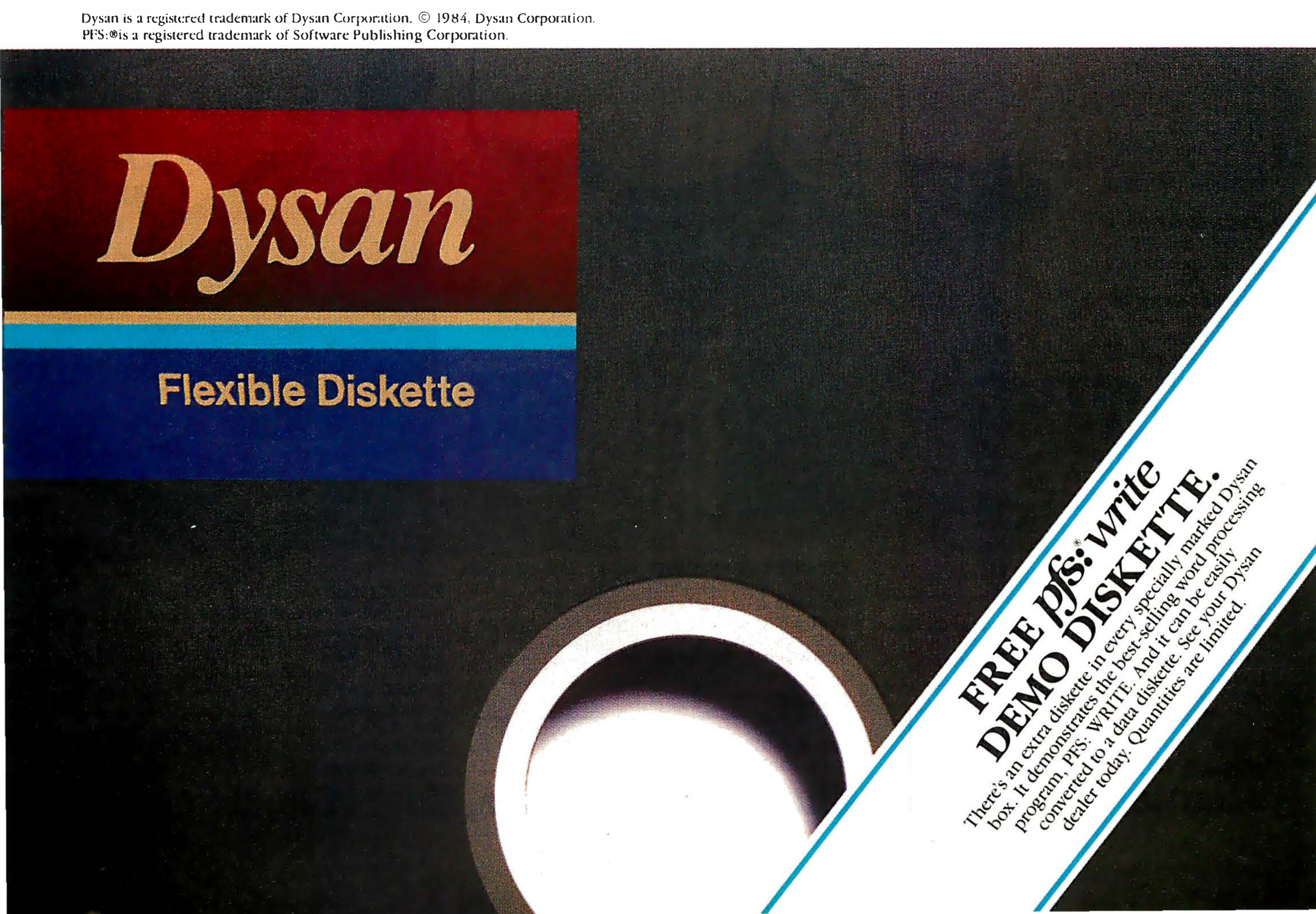
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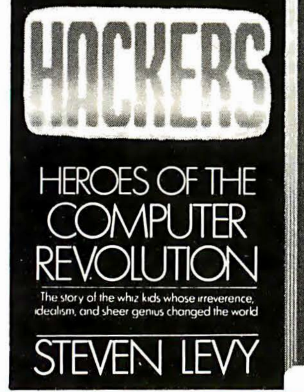


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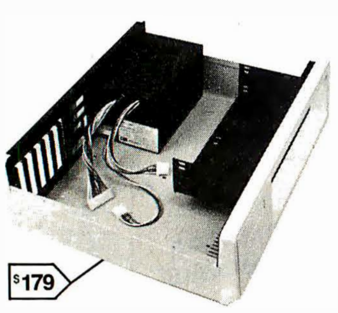
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sion. In this chapter, Lafore instructs us in the use of .BAT files for setting up assembly-language commands, including the passing of module names using dummy parameters 1%, 2%, and so on. This is the sort of thing that you see mentioned in IBM's documentation, but the mind-numbing effect of that documentation generally manages to hide anything of importance. Someone has to shake you by the shoulders and say, "Hey, this is useful!!" which is exactly what Lafore does throughout his book. That's why this is such a great book for programmers relatively new to the IBM PC.

Another advantage of Lafore's approach of centering on a specific machine is that you can gain good knowledge not only of assembly-language but also of the useful subroutines that are available in MS-DOS and in the IBM ROM (read-only memory). Many examples show how to take advantage of system routines, and the range of applications described in the book is large and rich. The author discusses sound, starting from one note and proceeding to sirens and scales. He also covers communication with the outside world, including the keyboard, video display, and printer; by the end of chapter 4, I was able to write several routines at the system level for changing print style on printed output. (Remember, this was my first crack at 8088 assembly language.)

In a large section on graphics, Lafore describes plotting in black and white or in color, one-point plotting, simple fill routines, and implementation of Bresenham's algorithm for drawing lines. He provides a solid foundation for doing graphics using machine language.

Another large section covers use of the disk from machine language, including implementation of sequential and random-access files. A final section discusses interfacing assembly-language programs with BASIC and Pascal programs. Appendix B contains eight machine-language programs for illustrative purposes, including a small file manager for keeping track of birthdays, and the famous Sieve of Eratosthenes for benchmarking.

There are many things I like about this book. First, it is well written; the disfiguring ignorance of the English language found in much computer-related writing is absent. Second, the author makes no presumptions about the reader's knowledge: everything is laid out, even if it involves some repetition, which, for learning, is not bad. Third, the important things in assembly language are emphasized: no getting lost in the weeds of binary arithmetic. Explanations are offered with the attitude that "here's something interesting you might like to know"; the author makes it clear which information he presents is essential to programming and what is simply background. Many texts present all information as being of equal (and high) importance, with consequent information overload for the reader. Finally, this book can substantially deepen your knowledge of the IBM PC operating system. This provides a perspective on the use of system facilities that cannot be obtained by perusing IBM documentation, and

(continued)

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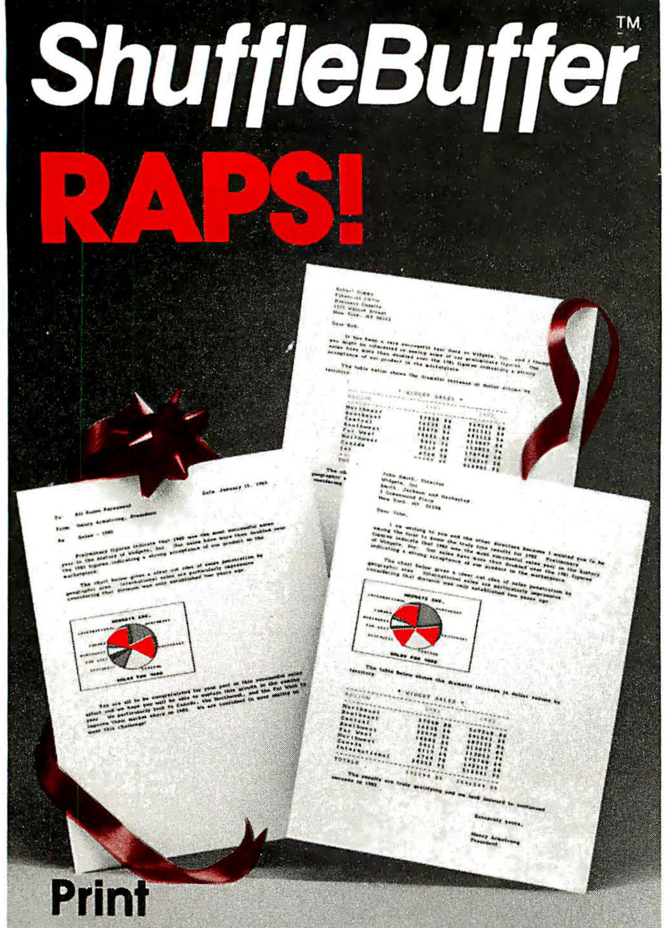
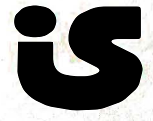
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which is likely to be unappreciated by the novice user.

In a reference to Appendix D (which covers the DOS functions), Lafore writes, "It might be educational for you to look through this appendix, just to get a rough idea of the kinds of things these calls do. Many of the descriptions will be mysterious to you at this point, but by the time you finish this book, you will be reading appendix D for relaxation, like the Sunday comics." The author points beyond the subject of assembly language and seeks to give the reader a broader knowledge of MS-DOS that can be used as a springboard for further learning. This quote, by the way, is an example of the informal, often humorous approach Lafore takes.

At $21.75 for a paperback, the price is a bit steep, even though the book has 500 pages. Nevertheless, it is a good value because it really does what it sets out to do: painlessly teach the beginner how to program an IBM PC in assembly language. In addition, it greatly deepens the reader's knowledge of the IBM operating system and provides a background that makes IBM's documentation comprehensible. Someone who knows nothing at all about programming or computers will not find this book useful; I came to it with some knowledge of machine language, although of a much different type (6502). But experienced programmers and anyone moderately skilled in writing BASIC would very much enjoy this book.

Assembly Language Primer is a language tutor, and it contains many good program ideas. Although it is well indexed, it is definitely not a reference text. And the word "Primer" must be taken literally since the advanced features of the IBM Macro Assembler are not described.

John Figueras (65 Steele Rd., Victor, NY 14564) is a retired research chemist who teaches computer science on a part-time basis at the State University of New York at Geneseo.

COMPUTER ETHICS: A GUIDE FOR THE NEW AGE
Reviewed by Mark J. Welch

Computer Ethics is an overview of many problems facing our newly computerized society. By addressing in a short volume the many ethical issues raised by personal computers, the author may make it easier for others to identify and expand upon them.

Douglas Johnson's background is religious, not technical, legal, or psychological. Thus the book contains more gut reactions than concrete examples, and the examples are from current popular media (mid-1983 newspaper and magazine articles). His intent is not to solve the problems or even analyze them carefully; instead, his goals are to show that computer ethics are desperately needed and to propose an approach.

Although Johnson's book is short and clearly written, it would have been more useful if it had been either expanded to include a more complete discussion or edited

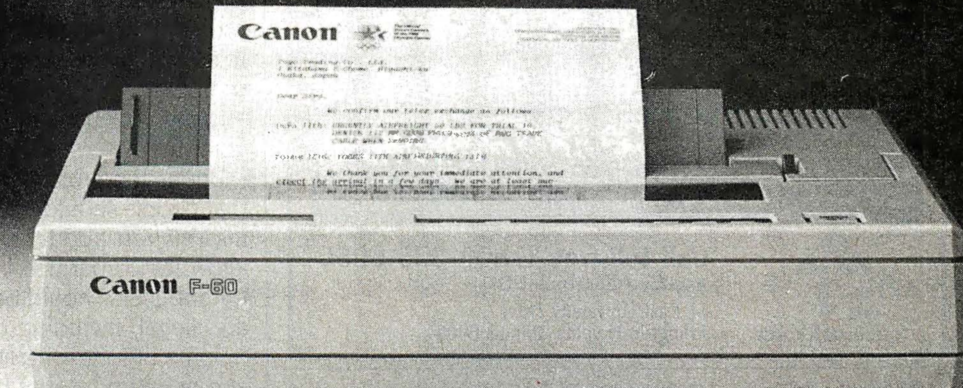
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Several problems raised in *Computer Ethics* have been addressed for many years by dozens of other books. The potential for error or abuse of large databases has been a popular topic. Likewise, computer "raiders" have received extensive coverage in the press. After reading far too much about both, I was glad that Johnson glossed over these problems.

I haven't seen much discussion of some other problems, however, and wish that Johnson had elaborated more on these. For example, he mentions the disparity in computer use between rich and poor students; the use of personal computers to download information and store it long after errors in the original file are corrected; and the problems raised by spending more time with computers than with people.

Johnson defines an ethic, explains why it is needed for computer use, and suggests a number of ground rules. Understandable, perhaps indisputable, are suggestions that people should be allowed to see and correct database information about them; that society must realize and allow for disparities in computer access; and that computer buyers should be warned about computer uses that are illegal, including copying programs.

Some of Johnson's suggestions are less understandable and would probably be met with strong opposition. His suggestions regarding computer piracy are idealistic. First, he suggests that we "make it illegal to sell computer programs that can break any type of security codes." Severe penalties for software pirates, another suggestion, seems more acceptable.

Next, he suggests that "a law could require companies to give a purchaser enough [backup] program disks at a reasonable cost so pirating is neither feasible nor attractive. . . . If the user is a manager in a corporation with multiple personal computers, [the company should] provide an inexpensive way to supply the corporation with a larger number of disks and manuals." While few people would dispute either point, I doubt many software companies *or* users would want a law specifying exactly what is a "reasonable cost" or an "inexpensive way."

Johnson also suggests that consumer laws be expanded to give more rights to computer buyers, and that laws prohibit storing certain types of personal information on personal computers.

To enforce the laws, Johnson suggests that "spot checks" be used. While this might help prevent software piracy, I suspect (and hope) the idea will never gain support.

I took issue with a number of Johnson's proposals and wished for better proof of several "problems" and a more thorough discussion of some issues. Nevertheless, *Computer Ethics* is a helpful overview of some issues that will undoubtedly be the subject of many books and articles in the near future. ■

Mark J. Welch is the User News editor for BYTE's Microbytes *section. He can be contacted at* POB 372, *Hancock,* NH 03449.

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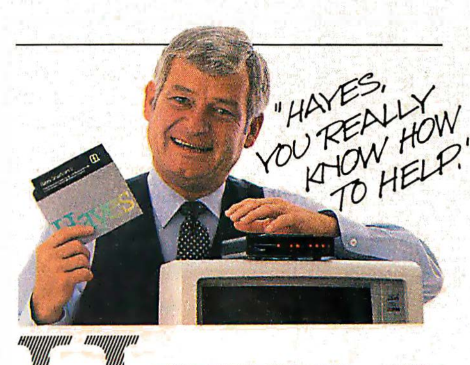
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December 1984

● dBASE, LOTUS DEMYSTIFIED—dBASE II and Lotus 1-2-3 Seminars, various sites throughout the U.S. Both seminars stress the practical applications of these two popular programs. The fee is $245 each or $450 for both. Contact Software Institute of America Inc., 8 Windsor St., Andover, MA 01810, (617) 470-3880. *December*

● ENGINEERING INSIGHTS Continuing Engineering Education, Washington, DC. Among the courses are "Hands-On Programming in the C Language," "UNIX: A Hands-On Approach," and "Internet Systems and Protocols." Tuition ranges from $730 to $875. Contact Dick White, Continuing Engineering Education, George Washington University, Washington, DC 20052, (800) 424-9773; in the District of Columbia, (206) 676-8515. *December*

● HI-TECH EXPLAINED Advanced Technology Seminars, various sites throughout the U.S. Among the topics to be explored are local-area networks, voice/data integration, CAD/CAM, WordStar, and Lotus 1-2-3. Fees range from $195 to $885. Contact Bernie Ilson Inc., 65 West 55th St., New York, NY 10019, (212) 245-7950. *December*

● INTEL WORKSHOPS Microcomputer Workshops, various sites throughout the U.S. and Canada. Intel, the semiconductor memory manufacturer, is offering more than 20 workshops on microprocessor applications. A brochure is available. Contact Customer Training, Intel Corp., 27 Industrial Ave., Chelmsford, MA 01824-3688, (617) 256-1374. *December*

● PROFESSIONAL EDUCATION—Seminars from the Institute for Professional Education, various sites in the U.S. Programs in statistics, management, simulation and modeling, personal computers, and computer science. Contact the Institute for Professional Education, POB 756, Arlington, VA 22216, (703) 527-8700. *December*

● SEMINARS FOR PROS Advanced Professional Education Seminars, various sites throughout the U.S. Seminar topics include the IBM PC, dBASE II, local-area networks, and UNIX. Fees range from $545 to $745. A calendar is available. Contact the Center for Advanced Professional Education, Suite 110, 1820 East Garry St., Santa Ana, CA 92705, (714) 261-0240. *December*

● CONFERENCES, MEETINGS—Conferences and Meetings of the Institute of Electrical and Electronics Engineers, various sites throughout the U.S. and the world. A calendar of conferences and meetings complete with contact persons is available. Contact IEEE Computer Society, POB 639, Silver Spring, MD 20901, (301) 589-8142. *December–January*

● REFRESHERS FOR ENGINEERS—Continuing Engineering Education, Washington, DC. Courses include "Communications Satellite Systems" and "Foundations of Modern Telecommunications Systems." Fees range from $795 to $920. Contact Continuing Engineering Education, George Washington University, Washington, DC 20052, (800) 424-9773; in the District of Columbia, (202) 676-8530. *December–January*

● DATA COMMUNICATIONS TAUGHT—Networks and Data Communications Short Courses, various sites throughout the U.S. A few of the courses to be held are "Introduction to Datacomm and Networks," "Designing Digital Communication Systems," and "Configuring Distributed Processing Systems." A catalog is available. Contact Integrated Computer Systems, 6305 Arizona Place, POB 45405, Los Angeles, CA 90045, (800) 421-8166; in California, (800) 352-8251 or (213) 417-8888. *December–February*

● DEVELOPMENT SEMINARS—Professional Development Seminars, various sites throughout the U.S. The Institute for Advanced Technology, a division of Control Data Corporation, presents seminars in a variety of areas, including data communications, database management, software engineering, CAD/CAM, personal computers, office automation, and personnel management. A catalog is available. Contact Institute for Advanced Technology, Control Data Corp., 6003 Executive Blvd., Rockville, MD 20852, (800) 638-6590; in Maryland, (301) 468-8576. *December–February*

● LEARN PERSONAL COMPUTING—New York University Programs in Personal Computing, New York City. Continuing education credits can be earned as you learn about personal computers, application programs, languages, communications, and microcomputer technology. Fees and session lengths vary. A brochure is available. Contact New York University, School of Continuing Education, Data Processing and Systems Analysis Institute, 327 Shimkin Hall, New York, NY 10003, (212) 598-7771. *December–February*

● INFO PROCESSING SEMINARS—New York University Seminars in Information Processing, various sites throughout the U.S. Seminars to be held include "Fundamentals of Information Processing for Nontechnical Executives," "The Management of Technical Personnel," and "Managing the Data Center." Contact New York University, School of Continuing Education, Seminar Center, 575 Madison Ave., New York, NY 10022, (212) 580-5200. *December–March*

● MANAGEMENT COURSES OFFERED Courses from the American

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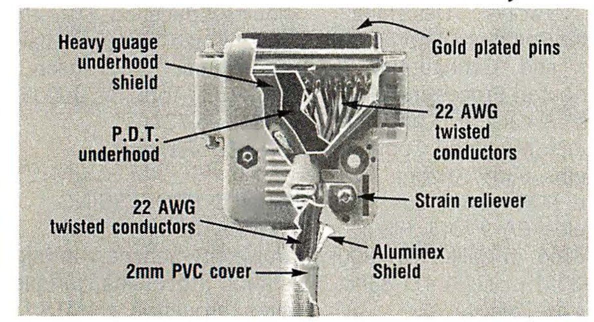
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Management Association, various sites throughout the U.S. The American Management Association offers a wide variety of courses in such areas as information systems, office automation, and communications. A catalog outlines each course. Contact American Management Associations, 135 West 50th St., New York, NY 10020, (212) 586-8100. *December–April*

● TRAINING IN KNOWLEDGEMAN—Training Seminar on KnowledgeMan, Chicago, IL. A two-day training seminar on the KnowledgeMan integrated information-management system for 16-bit computers. Contact KnowledgeMan Training Coordinator, Micro Data Base Systems Inc., POB 248, Lafayette, IN 47906, (317) 463-2581. *December* 10–11

● STRATEGIC ISSUES CONSIDERED—The 1984/1985 Strategic Issues Conference, Americana Canyon Hotel, Palm Springs, CA. The theme for this conference is "Positioning for Success in the New Computer Market." A keynote address will be delivered by John Sculley, president and chief executive officer of Apple Computer Inc. Contact Corky Holden, Info Corp., 20833 Stevens Creek Blvd., Cupertino, CA 95014-2107, (408) 973-1010. *December* 10–13

● COURSE COVERS C
C Programming: A Hands-On Workshop, Seattle, WA. This course explains how to design and write C programs and how to evaluate the C language for specific applications. The tuition is $995. Contact Irene Pasternack, Specialized Systems Consultants, POB 7, Northgate Station, Seattle, WA 98125-0007, (206) 367-8649. *December* 10–14

● FIFTH GENERATION COMPUTERS—Fifth Generation and Super Computers: An International Symposium, Rotterdam, The Netherlands. Lectures and panel discussions will be featured. Prototypes of several Japanese machines are expected to be shown for the first time outside Japan. Contact Fifth Generation and Super Computers Symposium 1984, Rotterdam Tourist Office, Stadhuisplein 19, 3012 AR Rotterdam, The Netherlands; tel: (010) 14 14 00; Telex: 21228 vvvnl. *December* 11–13

● DEC SHOW
DEXPO West 84, The Sixth National DEC-Compatible Industry Exposition, Disneyland Hotel, Anaheim, CA. Products and services that support Digital Equipment Corporation's machines will be displayed. Contact Expoconsul International Inc., 55 Princeton-Hightstown Rd., Princeton Junction, NJ 08550, (609) 799-1661. *December* 11–14

● TECHNOLOGY UPDATE—Hi-Tech Update '84, Delta Ottawa Hotel, Ottawa, Ontario, Canada. A series of presentations designed to inform senior management, engineers, and consultants. Sponsored by the Carleton University Faculty of Engineering. For further details, contact Conference Coll Inc., 1138 Sherman Dr., Ottawa, Ontario K2C 2M4, Canada, (613) 224-1741. *December* 12–13

● EDUCATIONAL COMPUTING—The Second Annual International Computers in Education Conference, Queen Elizabeth Hotel, Montreal, Quebec, Canada. More than 100 exhibitors and 125 speakers will participate in conferences sponsored by the McGill University Faculty of Education. For more information, contact GEMS Conference and

Consulting Services, POB 367, Snowdon, Montreal, Quebec H3X 3T6, Canada, (514) 735-1388. *December 12–14*

● MICROS MARCH TO ATLANTA—The Fourth Annual Southeast Computer Show and Software Exposition, Civic Center, Atlanta, GA. For details, contact CompuShows, POB 3315, Annapolis, MD 21403, (800) 368-2066; in Annapolis, (301) 263-8044; in Baltimore, (301) 269-7694; in the District of Columbia, (202) 261-1047. *December 13–16*

● CAD/CAM SEMINAR Carl Machover on CAD/CAM, Cathedral Hill Hotel, San Francisco, CA. Contact Carol Every, Frost & Sullivan Inc., 106 Fulton St., New York, NY 10038, (212) 233-1080. *December 17–19*

● SOFTWARE MANAGEMENT CONTROL—Configuration Management of Software Programs, Washington, DC. Intended to show those working in software management how to control development, maintenance, and operational costs. Familiarity with MIL-STD 480, 483, and 490 is helpful, but there is no prerequisite for this course. The cost is $730. Contact Stod Cortelyou, Continuing Engineering Education, George Washington University, Washington, DC 20052, (800) 424-9773; in the District of Columbia, (202) 676-8520. *December 17–19*

● BRIEFING ON ADVANCED LANGUAGES Structured Techniques Using Fourth Generation Languages, Dallas, TX. This seminar explains how structured techniques and fourth-generation languages can be used. The fee is $795. Contact Software Institute of America Inc., 8 Windsor St., Andover, MA 01810, (617) 470-3880. *December 18–20*

● BUSINESS GRAPHICS SEMINAR—Carl Machover on Business Graphics, Cathedral Hill Hotel, San Francisco, CA. Contact Carol Every, Frost & Sullivan Inc., 106 Fulton St., New York, NY 10038, (212) 233-1080. *December 20–21*

January 1985

● NETWORKS MADE CLEAR—Computer Seminars, various sites throughout the U.S. A series of seminars that covers computer databases and such applications as local-area networks and graphics. Contact Technology Transfer Institute, 741 Tenth St., Santa Monica, CA 90402, (213) 394-8305. *January–February*

● HANDS-ON LEARNING Hands-On Computer Seminars, Wintergreen, VA. Seminars offered are "Introduction to Personal Computing," "Word Processing/Information Management," and "Spreadsheeting/Graphing." Each spans a four-day period and provides 14 hours of hands-on practice. Rates, which include lodging and ski-lift tickets, vary from $570 to $975, depending on accommodations. Contact Dr. M. D. Corcoran, Wintergreen Learning Institute, POB 7, Wintergreen, VA 22958, (800) 325-2200; in Virginia, (804) 325-1107. *January–March*

● TELECOMMUNICATIONS CONFERENCES—Telecommunications Program, various sites throughout the U.S. "Satellite Technology for the Nontechnical Manager" will be offered. Contact Phillips Publishing Inc., Suite 1200N, 7315 Wisconsin Ave., Bethesda, MD 20814, (301) 986-0666. *January–May*

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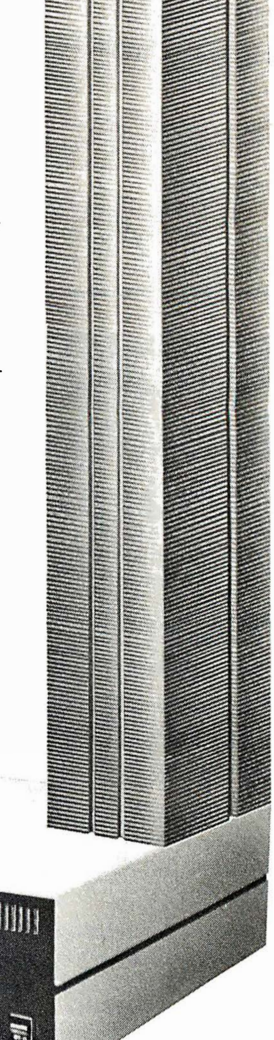
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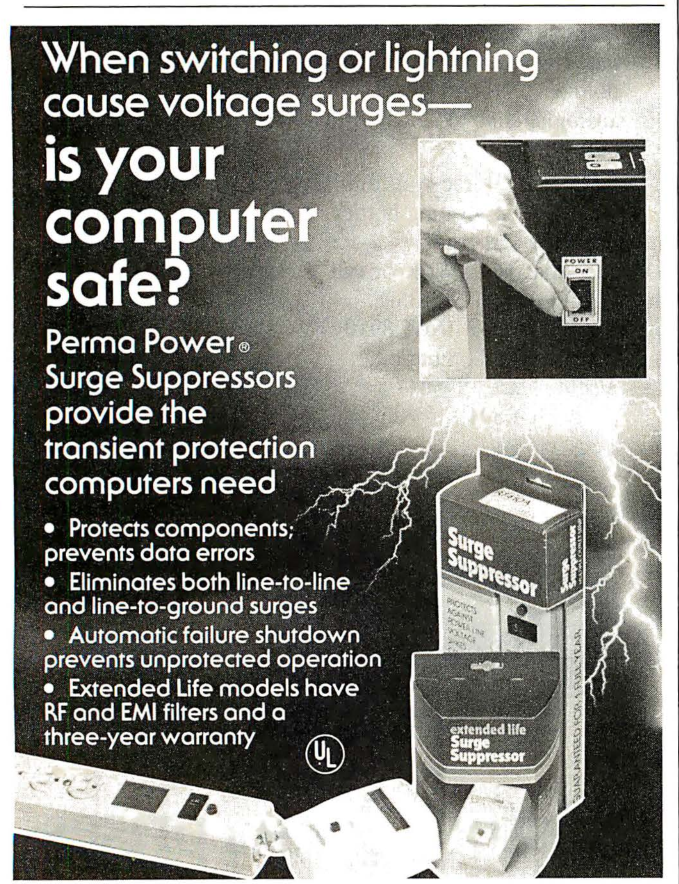
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● SME CONFERENCES, EXPOS—Conferences and Expositions from the Society of Manufacturing Engineers, various sites throughout the U.S. For a calendar, contact the Society of Manufacturing Engineers, Public Relations Department, One SME Dr., POB 930, Dearborn, MI 48121, (313) 271-0777. *January–November*

● SYSTEM SCIENCE EXAMINED—The Eighteenth Annual Hawaii International Conference on System Sciences: HICSS-18, Honolulu, HI. A series of conferences devoted to advances in information and system sciences. Major topic areas are hardware, software, decision-support and knowledge-based systems, and medical information processing. Contact Nem B. Lau, HICSS-18 Conference Coordinator, Center for Executive Development, College of Business Administration, University of Hawaii, 2404 Maile Way, C-202, Honolulu, HI 96822, (808) 948-7396. *January 2–4*

● PCB MANUFACTURING Printed-Circuit Fabrication Technical Seminar, Sheraton Twin Towers Hotel, Orlando, FL. Multilayer processing, trends in manufacturing and materials, and computer-aided manufacturing will be explored. The registration fee is $350, which includes materials, luncheons, and admission to a trade show. Contact Laura Harrel, PMS Industries Inc., 1790 Hembree Rd., Alpharetta, GA 30201, (404) 475-1818. *January 3–10*

● GIZMOS GALORE Consumer Electronics Show, Convention Center, Las Vegas, NV. One of the largest shows of consumer electronics products. Contact Consumer Electronics Office, Suite 300, 2001 Eye Street NW, Washington, DC 20006, (202) 457-8700. *January 5–8*

● MANAGE RESOURCES WISELY—Managing Computer Resources, Wintergreen, VA. Focuses on networking, system design, performance evaluation, and operational difficulties encountered by managers and executives. Rates include lodging and ski-lift tickets and vary from $570 to $769 depending on accommodations. Contact Dr. M. D. Corcoran, Wintergreen Learning Institute, POB 7, Wintergreen, VA 22958, (800) 325-2200; in Virginia, (804) 325-1107. *January 7–11*

● STERLING COMPUTER SHOW—The Fourth Annual Sauk Valley Computer Club Computer Show, Northland Mall, East Lincolnway, Sterling, IL. Businesses, schools, and users groups from the area will display and demonstrate computers and related services. Admission is free. Contact Sauk Valley Computer Club, POB 702, Sterling, IL 61081. *January 12–13*

● SCSI DEVELOPMENTS Small Computer Systems Interface (SCSI) Forum, Fort Lauderdale, FL. A seminar and exhibit devoted to SCSI controllers and peripherals. Contact Mr. J. Molina, SCSI Forum Ltd., POB 2625, Pomona, CA 91768-2625, (213) 410-3952. *January 15*

● BUSINESS COMMUNICATIONS—The Second Annual Business Telecommunications Exposition: BizTelCom Northeast, Aspen Hotel-Manor, Parsippany, NJ. Seminars and product displays. Preregistration is complimentary; $10 at the door. Contact Michael C. J. Houston, T. E. G. Inc., The Exposition Group, 83 Barnegat Blvd., Barnegat, NJ 08005, (609) 698-7020. *January 16–18*

(continued)

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AST 6 Pak Plus	$269
Smartmodem 1200B	$399
Quad Board Expanded 64K	$279
Smartmodem 1200	$489

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Word Perfect (SSI)	$249
WordPlus-PC with The Boss	$319
WordStar	$219
WordStar Professional (WS/MM/SS/SI)	$279
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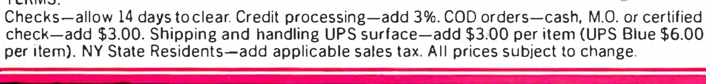
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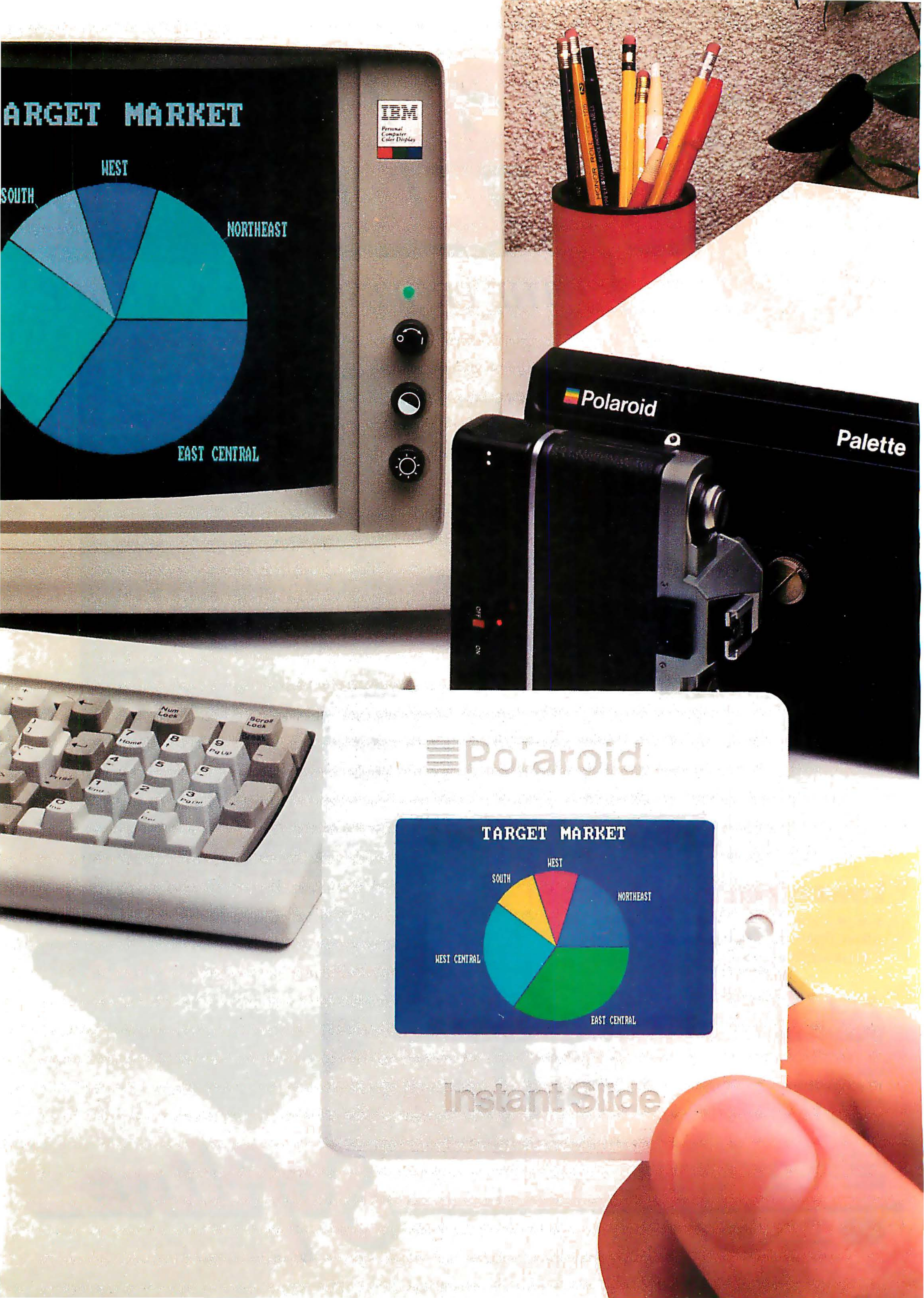

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● MEASUREMENT SCIENCE—Measurement Science Conference, Marriott Hotel, Santa Clara, CA. Technical sessions will explore such topics as laser and optical-fiber metrology, time and frequency measurements, and the effects of data networks on calibration. Exhibits and formal addresses highlight this event. Registration details are available from Darlene Diven, Measurement Science Conference, POB 61344, Sunnyvale, CA 94088-1344, (408) 756-0270. *January 17–18*

● OPTICAL ENGINEERING SYMPOSIUM—The 1985 Symposium on Optical and Electro-Optical Engineering and Instrument Exhibit, Marriott Hotel, Los Angeles, CA. This symposium, sponsored by the International Society of Photo-Optical Instrumentation Engineers (SPIE), is made up of conferences, exhibits, and tutorial short courses. Contact SPIE, POB 10, Bellingham, WA 98227-0010. *January 20–25*

● UNIX USERS UNITE
The 1985 UniForum: The International Conference of UNIX System Users, Infomart, Dallas, TX. More than 400 companies are expected to exhibit UNIX-related equipment. A conference program is planned. UniForum, sponsored by the /usr/group, will be held in conjunction with the grand opening of Dallas's International Information Processing Market Center (Infomart). Contact Professional Exposition Management Co., Suite 205, 2400 East Devon Ave., Des Plaines, IL 60018, (800) 323-5155; in Illinois, (312) 299-3131. *January 21–25*

● IN-FLIGHT COMPUTING EXPLORED—Meeting of the Radio Technical Commission for Aeronautics, Washington, DC. An industry committee will look into the possible effects that battery-operated portable computers may have on an airplane's navigational equipment. The committee, called SC-156, meets at 9:30 a.m. Contact the Radio Technical Commission for Aeronautics, Suite 500, 1425 K St. NW, Washington, DC 20005. *January 22–23*

● MICROS, COMMUNICATIONS, AND BUSINESS
Microspeak '85, San Francisco, CA. This conference will focus on ways to set up a cost-effective microcomputer communications system. The fee is $695. Contact Stephen J. Schneiderman, Micro Communications, 500 Howard St., San Francisco, CA 94105, (415) 397-1881. *January 22–24*

● SEMICONDUCTOR EQUIPMENT, CONFERENCE
Advanced Semiconductor Equipment Exposition and Technical Conference, Convention Center, San Jose, CA. Admission to the show is free with preregistration. Contact Joyce Estill, ASEE '85 Show Manager, Cartlidge & Associates Inc., 1101 South Winchester Blvd. #M259, San Jose, CA 95128, (408) 554-6644. *January 22–24*

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● COURSEWARE TIPS
Selecting and Evaluating Instructional Courseware, Princeton, NJ. This seminar shows teachers how to identify sources and the effectiveness of educational courseware, how to evaluate courseware, and selecting and using courseware directories, clearinghouses, databases, and published reviews. Hands-on experience is provided. The fee is $125. Contact Educational Testing Service, Princeton, NJ 08541, (609) 734-1108.
January 24

● INSTRUCTIONAL COMPUTING CONFERENCE
The 1985 Florida Instructional Computing Conference, Sheraton Twin Towers Convention Center and Howard Johnson's Florida Center Hotel, Orlando, FL. This fifth annual conference will feature more than 100 sessions on instructional and administrative computing as well as general conference sessions. More than 130 companies will exhibit. Contact the Florida Department of Education, Educational Technology Section, Knott Building, Tallahassee, FL 32301, (904) 487-3104.
January 28–31

● NETWORK CONFERENCE, EXPO—The Seventh Annual Communications Networks Conference and Exposition, Convention Center, Washington, DC. Contact Communications Networks 1985, POB 880, Framingham, MA 01701, (800) 225-4698; in Massachusetts, (617) 879-0700.
January 29–31

● GERMAN TRADE SHOW
Micro-Computer '85, Hall 4, Fairgrounds, Frankfurt, West Germany. More than 200 exhibitors of hardware, software, accessories, and services will display their wares. Other features include seminars, workshops, and discussions. Contact Mr. Philippe Hans, German American Chamber of Commerce, 21st Floor, 666 Fifth Ave., New York, NY 10103, (212) 974-8856.
January 29–February 3

● PAN AMERICAN CONFERENCE—The First International Information Management Congress Pan American Conference, Caribe Hilton International Hotel, San Juan, Puerto Rico. Seminars and product exhibits on advanced micrographics and office automation. Contact IMC, Pan American Conference, POB 34404, Bethesda, MD 20817, (301) 983-0604.
January 30–31

February 1985

● OEM CONFERENCES
OEM-Only Regional Invitational Conference, various sites throughout Europe. For a schedule, contact Beatrice Labbe, Conference Director—Europe, B. J. Johnson & Associates, 3151 Airway Ave. #C-2, Costa Mesa, CA 92626, (714) 957-0171. *February–March*

● AUTOMATED FACTORY EXPLORED—Automated Manufacturing, Don CeSar Hotel, St. Petersburg, FL. Contact Eleanor Bernet, Frost & Sullivan Inc., 106 Fulton St., New York, NY 10038, (212) 233-1080.
February 4–5

● TECHNOLOGY AND THE OFFICE—The 1985 Office Automation Conference, Georgia World Congress Center, Atlanta, GA. The theme for the sixth annual Office Automation Conference is "Today's Partnership: People and Technology." More than 45 technical sessions are planned.
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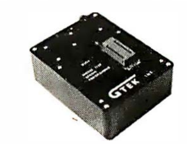
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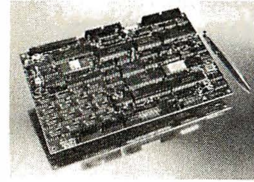
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High Speed CRT Controller
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Full-conference preregistration fees are $100, which includes admission to the exhibit area. Student, one-day, and exhibit-only rates are $10, $40, and $30, respectively. Full-conference registration at the door is $125. Contact OAC '85, American Federation of Information Processing Societies Inc., 1899 Preston White Dr., Reston, VA 22091, (703) 620-8952. *February 4–6*

● SHOW AND CONFERENCE—Mini/Micro West-85, Hilton Hotel, Anaheim, CA. A computer conference and exhibition. Contact Electronic Conventions Management, 8110 Airport Blvd., Los Angeles, CA 90045, (213) 772-2965. *February 5–7*

● MANUFACTURING EXPO Florida Computer Manufacturing Expo, Centroplex Expo Center, Orlando, FL. Hardware, software, peripherals, and accessories will be displayed. A seminar program is planned. Contact Great Southern Computer Shows, POB 655, Jacksonville, FL 32201, (904) 356-1044. *February 5–8*

● STRIDE TO FAIRE Stride Faire '85, MGM Grand Hotel/Casino, Reno, NV. This is the second annual technical trade fair sponsored by Stride Micro, formerly known as Sage Computer. Contact Laura Smith, Stride Micro, 4905 Energy Way, Reno, NV 89502, (702) 322-6868. *February 8–10*

● SOFTWARE MANAGEMENT CONTROL—Configuration Management of Software Programs, San Diego, CA. See December 17–19 for details. *February 11–13*

● COMPUTERS FILL EDUCATORS' TALL ORDER The Fifth Annual Conference of the Texas Computer Education Association, Hyatt Regency Hotel, Austin, TX. The theme for this conference is "New Directions for Education Using Modern Day Technology." Contact TCEA Conference, POB 2573, Austin, TX 78768. *February 13–16*

● COCO CONVOCATION Rainbowfest, Irvine Marriott, Irvine, CA. A show for users of the Radio Shack TRS-80 Color Computer. More than 50 exhibitors are expected. Contact Falsoft Inc., POB 385, Prospect, KY 40059, (502) 228-4492. *February 15–17*

● SOFTWARE UPDATE The Second Annual International Software Update, Waiohai Resort Hotel, Kauai, HI. An international lineup of speakers will focus on domestic and international marketing concerns and future trends in microcomputer software. Attendance is limited. Contact Raging Bear Productions Inc., Suite 175, 21 Tamal Vista Dr., Corte Madera, CA 94925, (800) 732-2300; in California, (415) 924-1194. *February 16–20*

● MICROS FOR EDUCATORS—Association of Teacher Educators National Conference, Riviera Convention and Resort Hotel, Las Vegas, NV. Exhibits and demonstrations of microcomputers, microcomputer products, and communications equipment will be featured. Contact Peter C. West, Learning Center, College of Education, Gabel Hall 8, Northern Illinois University, DeKalb, IL 60115, (815) 753-1241. *February 18–19*

● MANAGE YOUR COMPUTER—Managing Computer Resources, Wintergreen, VA. See January 7–11 for details. *February 18–22*

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EVENT QUEUE

● DIGITAL USERS MEET
DECUS Canada Spring Symposium, L'Hotel, Toronto, Ontario, Canada. This symposium covers a variety of topics of interest to Digital computer users. Contact Jeanne McNeish, DECUS, 100 Herzbug Rd., POB 13000, Kanata, Ontario K2K 2A6, Canada, (613) 592-5111, ext. 2782. *February* 19–22

● COMMUNICATIONS FOR EXECS—Info/Central, O'Hare Exposition Center, Chicago, IL. This show and conference on computers and communications is tailored to the needs of executives and data-processing managers. Mainframes, microcomputers, telecommunications systems, and micrographics are a few of the areas to be addressed. Contact the Show Manager, Info/Central, 999 Summer St., Stamford, CT 06905, (203) 964-8287. *February* 20–22

● COMPUTERS IN EDUCATION—The Role of the Computer in Education 5, Arlington Park Hilton, Arlington Heights, IL. A range of topics of interest to educators will be presented. Contact Rick Nelson, Micro-Ideas, 2701 Central Rd., Glenview, IL 60025, (312) 998-5065. *February* 20–22

● BUSINESS GRAPHICS
Computer Business Graphics, Bonaventure Intercontinental Hotel, Fort Lauderdale, FL. Contact Carol Every, Frost & Sullivan Inc., 106 Fulton St., New York, NY 10038, (212) 233-1080. *February* 20–23

● COMPUTER FAIRE
The Fourth Annual IEEE Computer Faire, Huntsville, AL. Sponsored by the Institute of Electrical and Electronics Engineers Inc. For more information, contact Terry Mizell, POB 5188, Huntsville, AL 35805, (205) 532-2036. *February* 22–23

● FARM AUTOMATION
Agri-Mation, Palmer House Hotel, Chicago, IL. This conference and exposition will focus on the role of automation in agriculture. Contact the Society of Manufacturing Engineers, One SME Dr., POB 930, Dearborn, MI 48121, (313) 271-1500. *February* 25–28

● COMPUTING IN ANESTHESIA—Computing in Anesthesia 85, The Third International Seminar, Miramar-Sheraton, Santa Monica, CA. Medical and computer specialists will describe their research and use of computers in data acquisition and display, monitoring, education, database management, and knowledge-based systems. The fee is $300. Contact the Program Chairman, Computing in Anesthesia 85, Anesthesiology Education Foundation, Federal Building, POB 24230, Los Angeles, CA 90024, (213) 825-7561. *February 25–March 1*

● AUTOMATION FOR ELECTRONICS—Automated Design and Engineering for Electronics, Anaheim Hilton and Towers, Anaheim, CA. A conference and exposition covering the design of electronic circuitry. Contact Michael Indovina, Cahners Exposition Group, Cahners Plaza, 1350 East Touhy Ave., POB 5060, Des Plaines, IL 60018, (312) 299-9311. *February* 26–28

● BETTER DOCUMENTATION—Writing Better Computer Software Documentation for Users, Atlanta, GA. A course to help you write clearly understood computer documentation. The fee is $475. Contact Elaine Hadden Nicholas, Department of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332-0385, (404) 894-2547. *February* 26–28 ■

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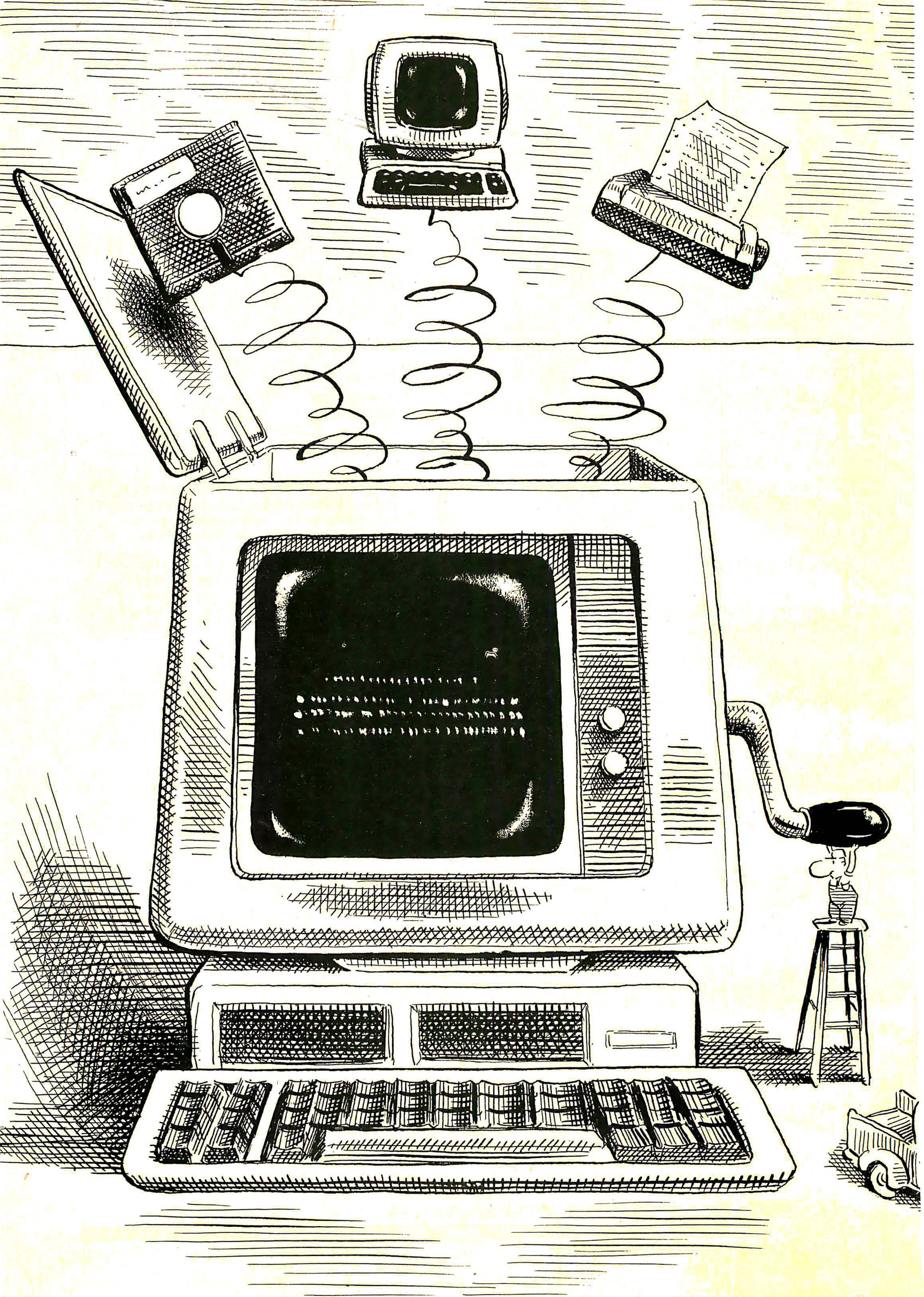
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Features

BYTE'S FAVORITE STORIES concern new technology and the extension of real computing power to more and more people. This month's features include articles in both categories. The Tandy 1000 doesn't break through any technological barriers—though it does make clever use of gate arrays to handle multiple graphics modes—but this new machine provides remarkable computing power at a surprisingly low price. The price seems even better when you've tried the software that Tandy bundles with the machine. Building on the ideas in the Model 100, Tandy has provided useful and friendly applications that work well with one another and present a consistent face to the user. The Tandy 1000 will give a lot of homes the advantages of a fully functional 16-bit machine.

Steve Ciarcia writes one article each month for BYTE. Writing the article is the easy part. The hard part is inventing the device that the article will describe. This month's invention is a 64-channel power I/O system. It can extend a computer's reach into the real world, even to the point of becoming an industrial-grade, closed-loop control system. If you'd like to make some changes in the way the universe operates, Steve's power I/O control system is a good place to start.

Despite its strengths, the C programming language doesn't always make things easy for the programmer. Now that C is popping up almost everywhere, programmer's aids are beginning to appear to help those of us who haven't had access to UNIX systems for the past 10 years. Mike Vose gives us a preview of three such aids: the Safe C Compiler/Profiler, which discovers run-time errors; the Instant-C interpreter, which reduces the need to cycle through the whole process of compilation; and the C Source Debugger, which permits debugging in C instead of in machine language.

Fiber optics promises to increase communications bandwidth and transmission speeds to such a degree that the community of personal computer users in North America will come closer together even as it grows more populous. There are already some local-area networks that use fiber optics. This new technology, which encompasses the fascinating phenomenon of total internal reflection, is one that we all need to understand better. To that end, Richard Shuford offers an introduction to fiber optics.

Finally, Gregg Williams examines another approach to software development, the world of software frameworks. A software framework is a program that defines much of an application program's standard operating environment, freeing the programmer to concentrate on the application. The result should be increased programmer productivity. Gregg takes a close look at the software framework embodied in Apple's Toolkit/32.

—Phil Lemmons, Editor in Chief

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BY G. MICHAEL VOSE

THE TANDY 1000

Editor's note: The following is a BYTE *product description. It is* not *a review. We provide an advance look at this new product because we feel it is significant. We plan to provide a complete review in a subsequent issue.*

THE TANDY 1000, Tandy Corporation's latest addition to its Advanced Technology Series (ATS), is fully compatible with the IBM Personal Computer (PC) and has a price ($1358.95) comparable to that of the IBM PCjr. In its minimum configuration of 128K bytes of memory, single 360K-byte disk drive, and monochrome monitor, the Tandy 1000 will run Flight Simulator and most other IBM PC and PCjr software.

The price of upgrading the Tandy 1000's memory and storage capacity is in keeping with a low-cost philosophy. Adding color involves simply attaching a color monitor; both monochrome- and color-monitor adapters are standard, as are many other features. The price of the Tandy 1000 includes MS-DOS 2.11, GW-BASIC, and a new integrated software package called DeskMate.

THE LINEUP

The Tandy 1000 (the word "Model" and the moniker "TRS-80" will no longer appear in the names of Tandy computers) carries a base price (without monochrome monitor) of $1199. This price includes a keyboard that is identical to the Tandy 2000's; a system unit containing an Intel 8088 microprocessor that runs at 4.77 MHz; 128K bytes of RAM (random-access read/write memory); monochrome- and color-monitor adapters; a television interface, which requires a separate RF (radio frequency) adapter; a double-sided double-density 5¼-inch disk drive (360K-byte capacity); a three-voice sound generator; a built-in speaker and audio output jack; a parallel printer adapter; twin joystick ports; a PCjr-compatible light-pen interface; and three expansion slots that accept Tandy or other maker's IBM PC expansion boards (as long as they are 10 inches or less in length). A dealer-installed second disk drive costs $299.95; user-installable options include a 128K-byte memory-expansion board with DMA (direct memory access) for $299.95; a 300-bit-per-second internal modem for $179.95; an RS-232C interface for $99.95; and the TRS-80 Touch Pad for $59.95. ATS monitors sell for $159.95 (monochrome) and $549.95 (color). Table 1 is a feature/price comparison of the Tandy 1000, the IBM PC and PCjr, and the Sanyo MBC-550.

THE TANDY APPROACH

The technology behind the Tandy 1000 breaks little new ground. The machine's engineering goals were low cost and IBM PC compatibility. To achieve these goals, some trade-offs and innovations were necessary.

The trade-offs involved making RS-232C circuitry optional and providing DMA circuitry only above 128K bytes of memory. Eliminating DMA hardware (hardware that enables direct transfer of data within memory or to and from peripherals, bypassing the microprocessor) from the circuitry on the Tandy 1000's motherboard (see photo 2) saves money at a minimal sacrifice in performance, particularly since DMA becomes crucial primarily for memory-hungry applications. Similarly, RS-232C circuitry is no longer essential in a world dominated by parallel *(continued)*

G. Michael Vose is a BYTE *senior technical editor. He can be contacted at* POB 372, *Hancock,* NH 03449.

printers and internal modems—it now falls into the category of special equipment.

The Tandy 1000's major innovation is a video-circuit redesign, which lowers costs and provides compatibility with the IBM PC and PCjr (see "Tandy Talks About the 1000" on page 103).

THE VIDEO CIRCUITRY

The engineering design of the Tandy 1000 incorporates a revamped video circuit that combines the techniques used to build the circuitry in the PC and PCjr. This design provides compatibility with both IBM machines but overcomes the inherent speed deficiencies of the PCjr video-circuit design. This is accomplished by a video gate array integrated circuit (IC) that works in conjunction with a Motorola 6845 CRT (cathode-ray tube) controller. The video gate array helped Tandy reduce costs by replacing a number of other ICs.

The video subsystem works in either color or monochrome mode. It drives either a monitor or, with an added RF modulator, a standard television set.

In alphanumeric mode, the video circuit displays characters in 80 or 40 columns by 25 rows. Sixteen foreground and background colors are available, except with character blinking, which reduces available background colors to eight.

In graphics mode, low resolution provides 16 colors and 160 by 200 pixels, medium resolution provides 4 colors and 320 by 200 pixels, and high resolution offers 2 colors and 640 by 200 pixels.

Like the PCjr's, the video subsystem of the 1000 shares RAM with the central processing unit. In the PCjr, this memory sharing requires that the central processor sit idle for as many as two out of every three microprocessor clock cycles. The Tandy 1000 design shares central-processor time more efficiently and seldom idles the microprocessor for more than a single clock cycle. The result is a faster display update rate, comparable to that of the PC, without sacrificing PCjr compatibility.

The custom video array in the Tandy 1000 also contains a 2K-byte ROM (read-only memory) character generator similar to the PC's. While many of the video's functions are susceptible to software control, this code is displayable only and cannot be read or written to by software.

IBM PC COMPATIBILITY

The Tandy 1000 is compatible with the IBM PC, with some exceptions, most of which will be important to system programmers but not to users. Some of these exceptions have been taken care of by the 1000's BIOS (basic input/output system), licensed from Phoenix Software (Norwood, Massachusetts), a purveyor of PC-compatible BIOS software.

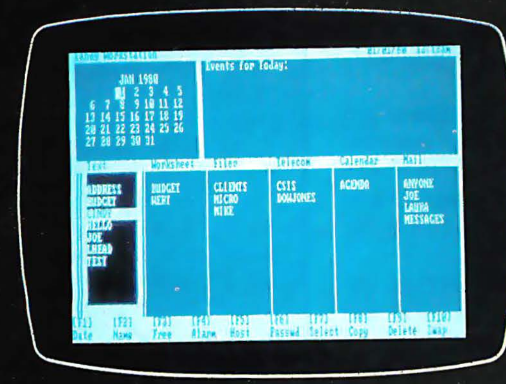
The Tandy 1000 keyboard, for example, is identical to that of the Tandy 2000. (See the product description "The Tandy TRS-80 Model 2000: A Powerful New MS-DOS Machine" on page 306 of the March BYTE; also see the system review "The Tandy Model 2000" on page 239 in this issue.) This keyboard produces scan codes at the hardware-interrupt level that are different from IBM's. Therefore, PC software that accesses keyboard ports directly will not function on the Tandy 1000. At the BIOS level, however, Tandy's ASCII (American Standard Code for Information Interchange) and extended ASCII codes are the same as those the PC generates, with a few exceptions; since the 1000/2000 keyboard has 90 keys, it generates all 83 PC scan codes plus a few of its own.

Because the Tandy 1000's video circuitry is substantially different from that of the IBM PC, software written for the monochrome adapter on the PC requires modification to run on the 1000. The underline attribute, for example, is not available for the monochrome monitor.

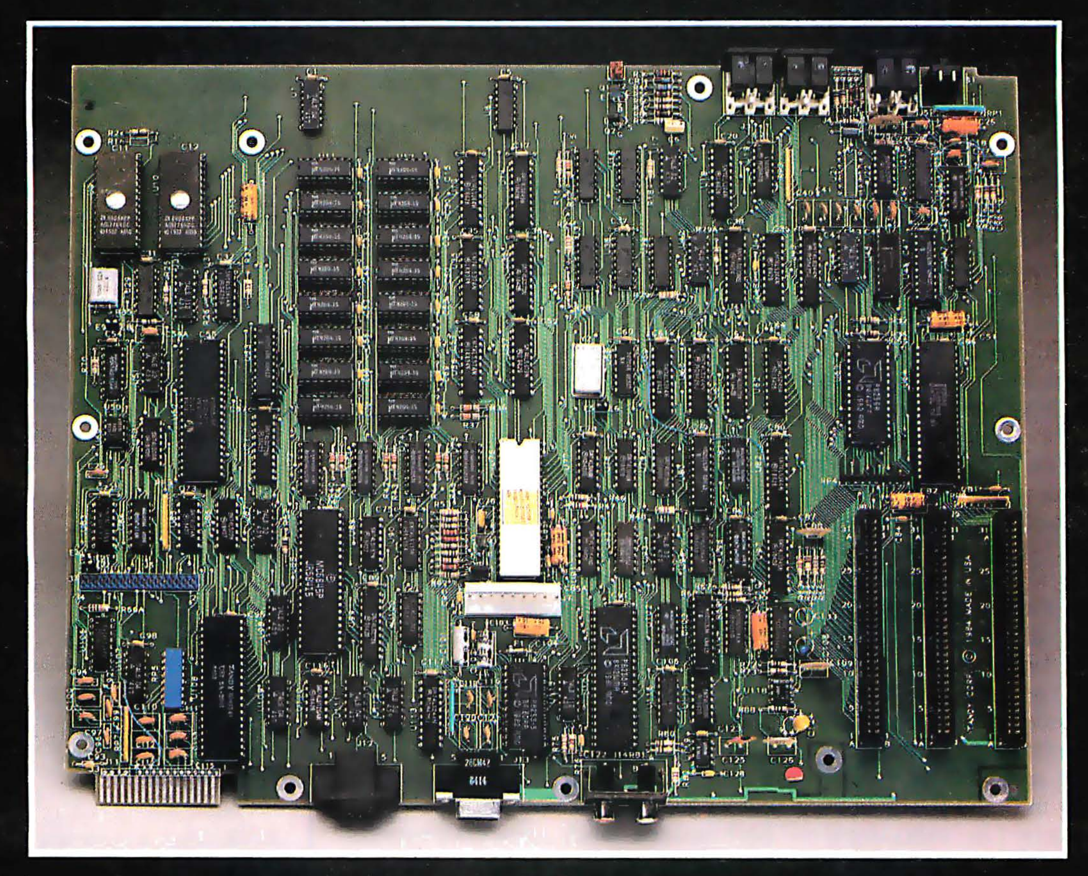
Like the PCjr, the Tandy 1000 uses 16K to 32K bytes of RAM for video memory, while the IBM PC stores video memory on the monochrome or color/graphics adapter board. And while BASIC resides in ROM in the PC, it is fully memory-resident in the 1000. Thus, the Tandy 1000 has less available RAM and will require more memory than the PC to run some PC applications.

As mentioned before, the Tandy 1000 gains DMA capability with the addition of the 128K-byte memory-expansion option. Therefore, applications that require DMA, such as serial communication or programs that require direct access to the floppy-disk controller, will require this memory upgrade.

IBM provides hardware switches that must be set to configure the PC for memory size and other functions. Such switches are absent from the Tandy 1000, which has ROM routines that determine the system's configuration on *(continued)*







The two screens at top display DeskMate, Tandy's integrated package that includes six software applications. The bottom photo shows the motherboard of the Tandy 1000.

boot-up and store this data in locations known to the BIOS. Software that reads IBM's switches rather than using BIOS calls for this purpose will require modification.

The Tandy 1000 joysticks are software-compatible with the PC (even though they remain hardware-compatible with the TRS-80 Color Computer). However, PC joystick programs may require a software timer and therefore may not run without modification on the 1000.

Some chip port addresses map into more than one memory location on the IBM PC. There are no dual mapped ports on the Tandy 1000. To run successfully on the 1000, software should address ports as documented in the IBM technical reference manual.

The Tandy 1000 is as compatible with the PCjr as it is with the PC. The major incompatibilities are similar to the PC incompatibilities listed earlier. Another difference is that the 1000 has no cassette interface. While not a compatibility issue, the 1000's sound-chip signal is available to both the internal speaker and the external audio jack, which means that sound-generating PCjr software can run without needing an external speaker.

Interestingly, the Tandy 1000 is less compatible with its larger brother, the Tandy 2000, than it is with the IBM PC. Put another way, the Tandy 1000 and the IBM PC are compatible with the Tandy 2000 in the same way; that is, the 2000 can read and write to Tandy 1000 disks, but the 1000 cannot use Tandy 2000 disks (nor can the IBM PC). The key to software compatibility at this level is the use of MS-DOS function calls.

SOFTWARE

Since it is an IBM PC-compatible computer, the Tandy 1000 uses MS-DOS (version 2.11) for its operating system. Tandy indicated it plans to offer its own versions of approximately 40 initial software packages for the 1000, including Lotus 1-2-3, Multiplan, Microsoft Word, DR Graph, Friday!, the PFS family, Finance Manager, and accounting and communications software.

Because the Tandy 1000 will not read Tandy 2000 disks, 2000 software will not run as is on the 1000. IBM PC programs will run, but with the exceptions noted earlier. In addition, the 1000 runs Microsoft's GW-BASIC and applications written in it, although it will not run PC-BASIC, a superset of GW-BASIC. Several educational packages are being readied for the 1000, many of which will be available by Christmas, including Facemaker, Kindercomp, and Alphabet Zoo.

The most popular software offering for the Tandy 1000, however, may prove to be DeskMate, an integrated software package that comes bundled with it. This package provides six main applications, including text editing, spreadsheet, file management, communications, calendar, and electronic mail, in a single system patterned after the TRS-80 Model 100's built-in software. DeskMate also provides several functions that are available at any time—even within its main applications—including help, a four-function calculator, an alarm keyed to the calendar, auto-dialing of any phone number in any file, printer formatting, and access to the system date.

DeskMate is an introduction to productivity software, envisioned as an offering that will provide usable software without additional expense. As such, the individual applications do not provide the same functionality as stand-alone products. The spreadsheet, for example, offers only 99 rows by 99 columns. Written partly in C and partly in assembly language, DeskMate provides what might be described as "executive-level" performance. Tandy apparently expects users who require high-powered applications to purchase those separately.

The design of DeskMate emphasizes integration and simplicity. A central display area lets you share files among applications (see photo 1). Also, the applications make heavy use of the 1000's function keys, and they use the same keys for similar functions, regardless of the application.

The DeskMate text editor offers standard insert/delete/overtype functions plus rudimentary block operations, including block move and block delete. You can merge files, but the editor limits the formatting of files to control of the left and right margin size, page size, and a choice of single- or double-spacing of lines.

The DeskMate spreadsheet provides average, summation, maximum and minimum value, and transcendental functions. You can specify portions of the spreadsheet as text, within which you can use text-editing functions. Format commands provide integer, dollar, and decimal formats plus right and left justification. You can embed an input request in a spreadsheet cell using a question mark followed by a prompt string so that during a subsequent calculation, the pro- *(continued)*

At Tandy Corporation headquarters in Fort Worth, Texas, we spoke with people involved with the Tandy 1000 project, including John Patterson, vice president for research and development; Bill Wilson, director of computer development; Dale Chattam, manager of computer design; and Ed Juge, director of computer marketing.

BYTE: *What did your engineering team do to enable you to build, essentially, an* IBM PC *and sell it for substantially less than* IBM *does?*
TANDY: First of all, we started off with very strict goals for costing. Our target price was lower than we wound up at but, as with most projects, we kept adding features and ended up with a little higher price point. We are also friends with the designers of the Color Computer and they have a technology of low-cost design that's evolved over time. Beyond that, frankly, we borrowed some ideas from IBM. We took a look at the PCjr and the PC, and it turned out that there's not a lot of difference in the cost of the electronics between the PC and the PCjr. We basically took the best features of both products, from a cost standpoint. We also have all of our logic circuitry on one board, compared to the PCjr, which has a main logic board, a memory board, and a floppy board. The PC has a main logic board, a floppy board, and a video board. Going to one board as opposed to three was a major cost advantage.

BYTE: *Was the decision to leave* DMA *off the main* CPU *board done for cost reasons?*
TANDY: Sure. We felt that most 128K-byte programs would be PCjr-type programs, and the PCjr didn't have the DMA. It's only when you are running a certain class of program—programs that need 256K bytes of memory, the real PC programs—that you need DMA. So you only pay for it when you need it.

BYTE: *That's a clever idea.*
TANDY: It's actually a straightforward thing to do, we'd just never done it before. We don't know if anyone else has or not.

BYTE: *Another design decision that you made to save money was to offer* RS-232 *circuitry as a separate optional board.*
TANDY: That was a trade-off. The choice there was to go with the parallel interface for the printer as opposed to RS-232, since all of our printers are parallel printers. People that are using an RS-232 are basically going to be using a modem, and these days modems are less often something you buy and plug into an

Tandy Talks About the 1000

RS-232 port—they tend to be built in and so forth. So the decision not to build in an RS-232 was a matter of volume for the machine, not a technical problem.

BYTE: *Is there anything else that you've done from an engineering standpoint that contributes to your ability to make this machine at a significantly lower cost?*
TANDY: Well, for one thing, the project started off with the concept that we had to design some custom parts in order to make it acceptable from a cost standpoint. The video circuit that we designed, for example, is a custom part. You get an awful lot of function out of it for low cost. We designed another custom part for the printer interface. We took about a dozen ICs [integrated circuits] and rolled them into one small custom IC. We've also been aggressive about forecasting high volumes and going after our vendors to buy the parts at the right price.

BYTE: *Are you dealing with any major component shortages?*
TANDY: As a matter of fact, we've seen a recent turnaround. Availability is improving on memory parts and on some of the 8088-series parts. We've seen some better pricing in the last month or two. The whole industry appears to be loosening up a bit.

BYTE: *Is this machine built so that you can take advantage of economies of scale, and perhaps drop the price if you have to, to stay competitive?*
TANDY: We would never have designed a computer without that in mind. If you do, you're just not going to be in business for long. On the other hand, there's nothing outrageously unusual done to accomplish that. For example, we are taking more and more advantage of custom circuit design, which is the way the industry is going. We're pursuing an aggressive cost-reduction program on this machine already, as well as on our Tandy 2000, so that we'll have the option to do what we want to in the future.

BYTE: *Compare the 1000 to the IBM PC and PCjr for us. What's different?*
TANDY: Well, the video circuitry, for one thing. That design is the heart of the machine. We managed to overcome some of the problems the PCjr has. The basic architecture of the two machines is the same, but the implementation is different.

IBM advertises in its manual, for example, that the PCjr has two wait states on the memory accesses. But by our measurements, it is more on the order of six wait states. We wound up with between one and two wait states. We basically had a chance to take their approach, see the flaws in it, and reengineer it. You can always reengineer something and do a better job. So our machine is quite compatible with the PC, and yet it is more like the PCjr in terms of the architecture.

BYTE: *Did your design both increase speed and decrease cost?*
TANDY: Well, it decreased cost over the PC and increased the speed over the PCjr. The architecture conceptually is similar to the PCjr in the way the video's set up. Basically, they need to do two video accesses in a fixed period of time, 1.1 microseconds. We went in and designed the memory circuitry just a little bit tighter to provide for four accesses in that same time frame. What we did was to give the video every other access and the CPU every other access so that now you get the CPU in there twice during the same time period. Thus the average wait to get to the CPU memory goes down from a maximum of 1.1 microseconds to half of that.

We ran some benchmarks and found that a BASIC program running out of ROM on the PCjr is slower than the same program running entirely out of video memory on the 1000. In fact, the PC was benchmarked at 24 seconds, the 1000 was benchmarked at 23 seconds, and the PCjr was benchmarked at 29 running out of its ROM BASIC. So we think we're comparable in speed to the PC.

BYTE: *Was that with or without DMA?*
TANDY: That was without it. Now, when we added the extra memory in, that increased our speed and we were benchmarked at 21 seconds. So with 256K bytes of memory or more, I think we may run slightly faster than the PC. The PC, as you may know, has one fixed wait state in every memory access. They designed that several years ago when memory parts weren't quite as fast as they are today.

BYTE: *Is there anything else about the Tandy 1000 that makes it technologically different from the PC?*
TANDY: Well, since we were after compatibility, we didn't get a lot of freedom. We do have the Tandy 2000 keyboard, which is a very good keyboard, technologically—we put a lot of money into it to make it better. There are also a few minor improvements in the video. For example, in text mode, our video gives you slightly better separation between lines and characters. That's a minor thing, but it will make the text more readable on the color monitor. We also have more colors than the PC does, 4 colors in the 640 by 200 resolution mode and 16 colors in 320 by 200. We did leave out the hi-res, hi-dot-rate mode, however.

We think we did a slightly more clever design in how we took advantage of the memory circuits and so forth. Also, there were some limitations on the PCjr that there was no reason for. But then, we didn't have to worry about knocking off one of our other machines when we designed the 1000, so we didn't put any restrictions on it. Still, if somebody is going to knock off your machine, it's probably better to do it yourself than to have somebody else do it. IBM apparently didn't reason that way.

BYTE: *How hardware-compatible is the 1000 with the IBM PC?*
TANDY: If there are expansion cards, for example, that are compatible with the IBM PC, and they are not over 10 inches long, they can be plugged into the 1000.

BYTE: *Including IBM PC serial cards?*
TANDY: We have tested IBM serial cards, in fact, the card we are going to offer is basically 100 percent PC-compatible. Of course, the cards we offer would also plug into an IBM if anyone wanted to buy them for that purpose.

BYTE: *Did you consider a higher clock speed for the CPU board to give you a performance advantage over the PC?*
TANDY: That's a compatibility issue, too. To get the maximum compatibility, you have to run at the same clock speed. The 2000 is our high-performance system. If people want high performance, that's what they ought to be buying. With the 1000, we've been trying to get equivalent performance. There's another complicated issue here. Our video timing and our CPU timing is tightly interwoven in order to share memory. So even if you were to run the CPU faster, you wouldn't be able to take full advantage of that higher clock speed. It would probably be a lot more difficult to design it that way, also.

BYTE: *Did what you learned in building the 2000 contribute significantly to the 1000's design? Namely, did you save any money?*
TANDY: The design methodology of the 2000 helped us determine how to set up the program, how to staff it, how long it would take to get the design done, and some things about working with custom-IC vendors. But the two designs are not architecturally very similar. The 2000 uses a lot of new technology.

PRICES	Tandy 1000	IBM PC	IBM PCjr	Sanyo MBC-550
Base unit	$1199.00	$1995.00	$999.00	$999.00
128K-byte expansion	$299.95		$325.00	$240.00
Color adapter	standard	$244.00	standard	standard
Parallel port	standard	$75.00	$99.00	standard
Serial port	$99.95	$100.00	$45.00*	$100.00
MS-DOS	standard	$65.00	$65.00	standard
BASIC	standard	standard	$75.00	standard
Power adapter			$150.00	
Total	$1598.90	$2479.00	$1758.00	$1339.00
FEATURES				
Monochrome graphics	standard	optional	standard	standard
Color graphics	standard	optional	standard	standard
DOS	standard	optional	optional	standard
BASIC	standard	standard**	standard**	standard
Bundled software	one***	none	none	six
Expansion slots	three	five	none	none
Hard disk	optional	optional	none	optional
Parallel port	standard	optional	optional	standard
Serial port	optional	optional	optional*	optional

* The PCjr's serial port requires a $45 adapter cable.
** IBM's standard BASIC is in ROM and cannot write to disk.
*** The Tandy 1000's one bundled software package includes six applications.

Table 1: *A comparison of the prices and features of the Tandy 1000 with the IBM PC, the IBM PCjr, and the PC-compatible Sanyo MBC-550. The base prices include a system unit with 128K bytes of RAM (except the IBM PC, which comes with 256K bytes of RAM) and a single 360K-byte disk drive. Note that the IBM PCjr requires a power-supply adapter if both the 128K-byte memory expansion and the parallel port are installed.*

gram will wait for data input before proceeding.

The list manager, called the Filer, is a screen-oriented database manager, at least in terms of forms creation. You title fields within the first 20 characters of a screen line and can use the rest of the line for the data portion of the field. You can add more lines, up to a maximum of 255 characters per field. The total number of single-line fields (or fields plus extra lines within fields) is 21. You can also specify the field for automatic sorting of the file so that when new records are added, they are inserted in proper sort order.

You can display or print the data in a Filer data file in horizontal format, showing only part of each record, according to any criteria specified by the Find command's parameters. You can copy data from a Filer data file into a text file.

Electronic mail capability lets you create messages for transmission to other DeskMate machines by the Telecom application.

CONCLUSIONS

The DeskMate software adds sufficient value to the Tandy 1000 to make the computer a significant offering, regardless of configuration. The PC clones have not come bundled with software except in a few cases, such as the Seequa Chameleon or the Sanyo MBC-550. This software generally is an amalgam of moderately successful programs from years past. An integrated application designed for limited workstation-like tasks seems a better approach than giving away full-blown applications to a buyer who probably prefers to choose his own word-processing or spreadsheet software.

In appearance and feel the Tandy 1000 closely approximates its larger brother, the Tandy Model 2000, but it is not identical to the previously announced PC/XT-like Tandy 1200 (see page 42 of the What's New section in the November BYTE). Like most IBM pretenders, the Tandy 1000 is not 100 percent compatible; however, it appears to be as close as any other compatible, plus it offers more PCjr compatibility than even a PC.

Since Tandy tightly controls the making of its computers, it should be able to respond to future IBM price drops for the PC series. Tandy's electronics line is diversified enough to guarantee that the company will be around to provide service for its products—a consideration not to be overlooked. ■

BUILD THE POWER I/O SYSTEM

BY STEVE CIARCIA

Controlling the power to the real world with your computer



If you've been reading the Circuit Cellar for any period of time, you've probably noticed that I have a definite prejudice toward computer control. You'll never read about the merits of various DOS (disk operating system) utilities in a Circuit Cellar project, but it is conceivable that you'll come across a computerized, time-of-day-activated dog feeder.

Seriously, though, over the years I've presented a variety of sensors, monitors, and controllers that could turn your computer from a mild-mannered games machine into the HAL 9000 of the neighborhood. These capabilities, be they menacing or beneficial, are directly the result of making the computer aware of the real world.

I define "real world" as conditions that occur external to the computer. A 100-watt table lamp next to your computer is in the real world. The computer is unaware of the lamp's presence because the computer is not connected to the real world. Unless something happens within the address and memory space of the computer, however, it is unaware that anything else exists.

To remedy this condition of ignorance, we must construct an interface that allows the computer to recognize the occurrence of real-world activities and respond accordingly. This real-world interface is a translational device of sorts: the computer sees it as simply another addressable peripheral device, such as a cassette recorder or printer, yet the information communicated comes from the real world or is directed to the control of real-world events, such as turning on the lamp.

In the case of the lamp, the appropriate control element would be an electronic substitute for the mechanical switch to turn the light on and off. However, is the light really on? Of course we can see it, but, unless we provide additional sensing capability, the computer knows only that it has turned the light on, not that it *is* on.

Additional real-world conditions must be monitored to know this with certainty. One way is to physically read the 115 volts (V) AC applied to the bulb or monitor a thermostatic sensor attached to the bulb.

All this might sound absurd, but that is because we take for granted that it is easy to turn a light on and see that it is in fact on. In critical control situations, more than simple on/off activation is required. Fre-

(continued)

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quently, as in industrial applications, both the actions and the results must be monitored to produce reliable control conditions. (Open-loop control systems such as the BSR X-10 are generally unsuitable for industrial applications.)

One of the prime components of any real-world interface is discrete-bit AC/DC power input and output, which is on/off control and monitoring of 115-V AC or 5- to 48-V DC devices. With an AC/DC power I/O (input/output) interface, we can control and monitor motors, lights, high-voltage AC systems, and process-control and monitoring devices.

This month's project is a discussion of the design and construction of an AC/DC power I/O (power I/O hereafter) interface with particular emphasis on the internal configuration of the solid-state relays (SSRs) and receivers. The emphasis is on an industrial quality-control interface that meets the needs of both the experimenter and the industrialist. Beyond the homebrew relays and receivers that you can build, I'll describe a true closed-loop power I/O control system using the Circuit Cellar Z8-based computer system (which I've described and used numerous times) and commercially available components.

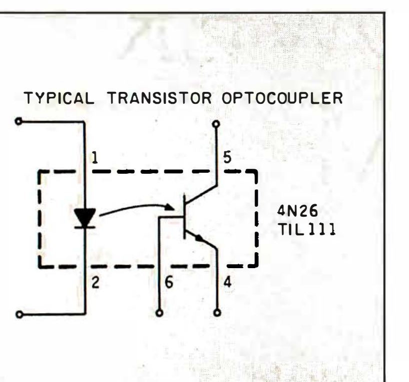


Figure 1: A *typical transistor optocoupler.*

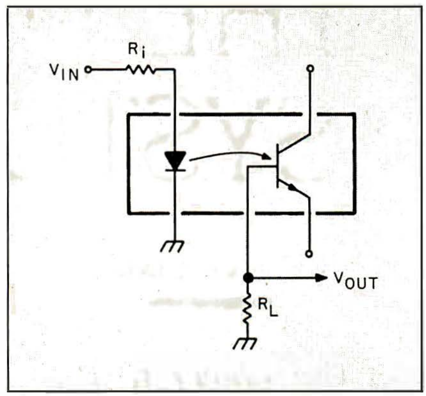


Figure 2: *Figure 1 used as a high-speed diode-diode optocoupler.*

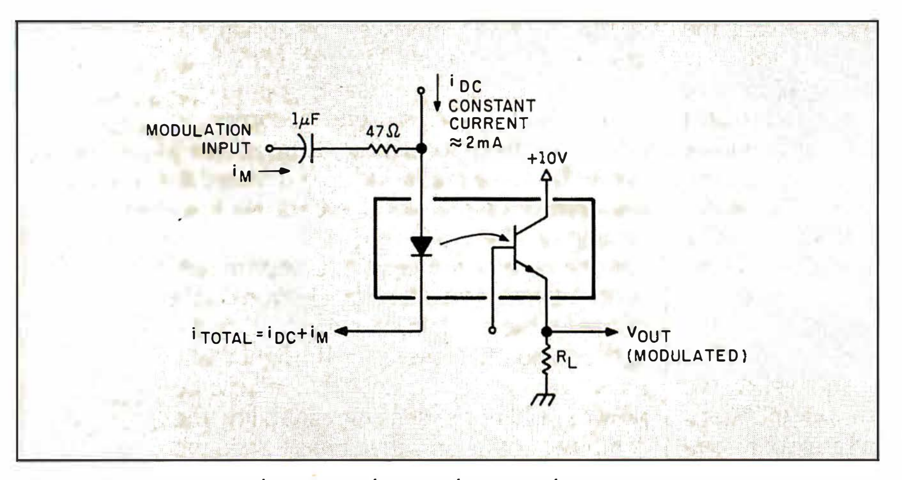


Figure 3: *Figure 1 used as an analog-signal optocoupler.*

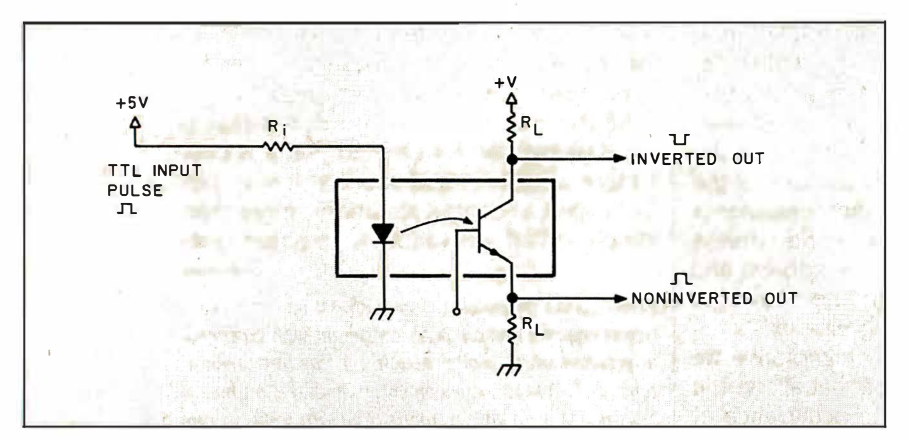


Figure 4: *Figure 1 used as a digital-signal optocoupler.*

A Discrete-Bit Interface

Generally speaking, most computers are parallel in function. If you are using an Apple II or IBM PC, communication between the processor and its peripheral devices is handled 8 bits at a time presented in parallel. A parallel printer, for example, receives its character data as a 7- or 8-bit parallel word and sends its status and operating conditions back in a similar manner.

Most peripheral devices use all 8 bits at a time because they are most often communicating 8-bit data or ASCII (American Standard Code for Information Interchange) characters. Externally connected devices such as a light and a thermostatically controlled switch are single-bit devices. However, since the internal function of the computer is word rather than bit wide, each bit of the 8-bit word is used to separately receive or control an external event. If it were a 16-bit computer such as the 68000, each word would have 16 discrete bits of I/O.

Within the computer, one or more memory locations (or I/O port locations if it's a Z80 or 8080) are set aside and the addresses decoded as parallel I/O ports. If configured for output, each bit in a port is then connected to a discrete module that converts the TTL (transistor-transistor logic) level presented to it to a high/low, on/off voltage-level output. If the module is for AC control, it will convert a TTL high to 115 V AC and a TTL low to 0 V AC. DC output modules function as simple contact closures with the voltages dependent upon your proposed application.

When the addressed location is an input port, each bit is attached to an input receiver that converts a high-voltage input level to a TTL logic 1 and a low-voltage input level to a logic 0. The exact range and switch point

of the module have to be selected for the application, and there are differences depending on whether the applied voltage is AC or DC.

With a single parallel I/O location (port), eight separate devices can be controlled and eight discrete events monitored. To properly coordinate the activity, bit rather than word manipulation becomes essential.

The I/O modules provide level conversion and isolation between the computer and the external device. Depending upon the components employed, I/O interfacing need not be a prodigious task.

Isolation Is the Key

The most important factor in I/O interfacing, especially with AC line voltages, is isolation. The computer you are using most likely operates on 5 V. If 115 V AC is applied to an unisolated input port, you are definitely going to produce smoke! High-voltage inputs must be safely converted to 5 V, and output devices must have no way to inadvertently feed 115 V AC back into the computer.

The simplest isolation device is the electromechanical relay. You can easily attach a reed relay to each output bit and the isolated contacts used to switch the AC line. Similarly, you can connect the external voltage to a relay whose contacts are attached to an input bit. When the input level is high enough (determined by series resistors), the contacts close and the computer senses the condition.

There is nothing wrong with using relays. For many years, this was the only method available, and it still works, to a point. However, relays are large, expensive, slow, electrically noisy, and subject to wear. They have been replaced with solid-state optoelectronic components that are small,

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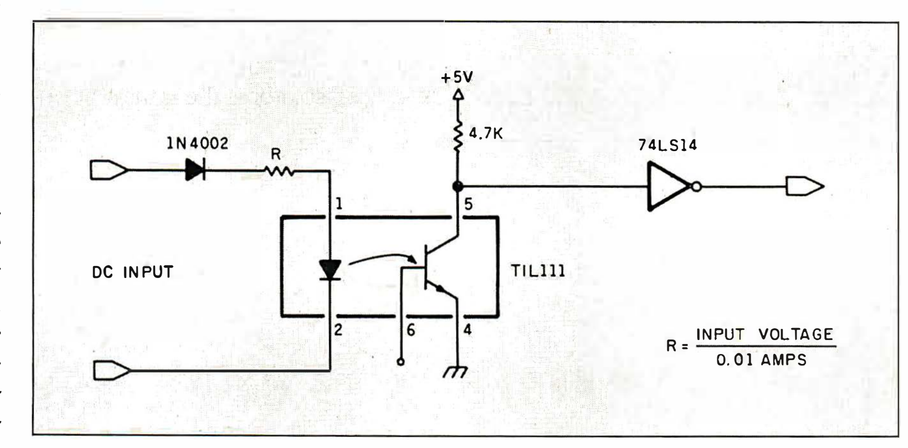


Figure 5: A DC *input receiver.*

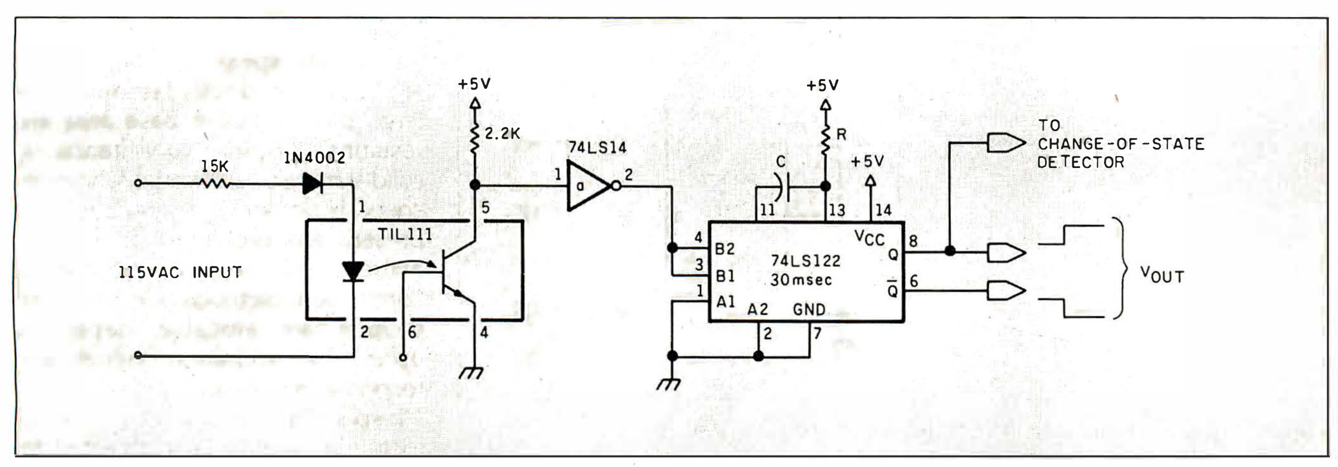


Figure 6: A *half-wave* AC *input receiver with constant-level output.*

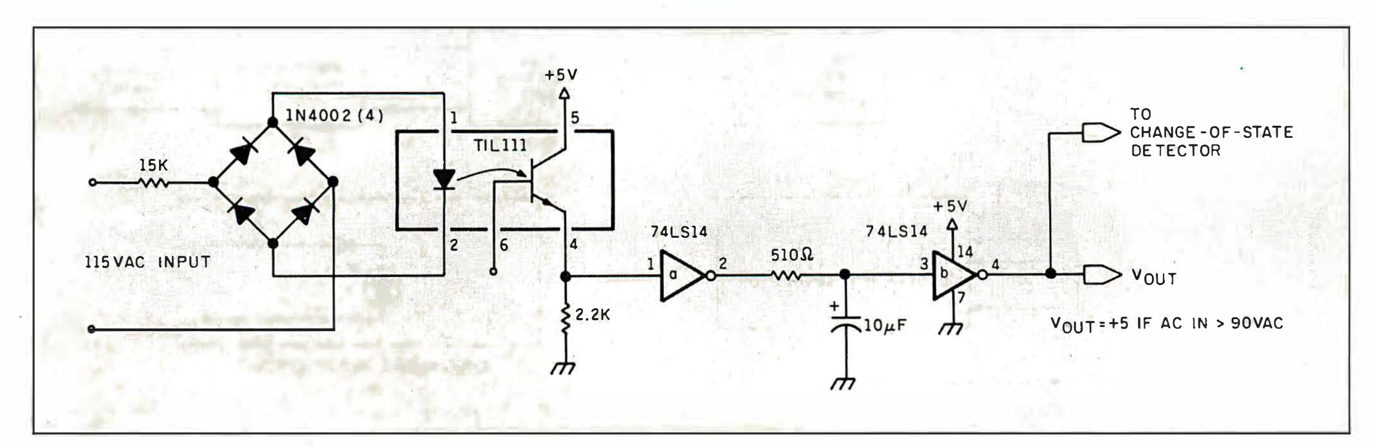


Figure 7: A *full-wave* AC *input receiver with constant-level output.*

Generally speaking, optocouplers are not tremendously fast due to the large photosensitive base area and the resulting junction capacitance.

inexpensive, fast, optionally noiseless, and have no wear in proper use.

Inside an Optocoupler

The essential ingredient in this project is the optoisolator and its use as an I/O control device for AC and DC voltages. With it, we can configure high-performance solid-state relays and solid-state input receivers. The exact configuration, as I will explain, depends upon the application and the excitation source.

The simplest and most frequently used optoisolator is the transistor optocoupler. It consists of a GaAs (gallium arsenide) infrared LED (light-emitting diode) and a silicon NPN phototransistor separated by a glass partition. The thickness of the glass determines the isolation level of the component. A typical isolation value is 1500 V. This means that the potential difference between the input and output sides of the optocoupler must be less than 1500 V, or it will break down and expose the computer to hazardous voltages. (While this seems unusually high, remember that these relays often switch inductive loads that produce high-voltage transients. Proper "snubbing" and transient suppression must be employed or these limits can be exceeded.)

Figure 1 is the typical transistor optocoupler. A current is applied to the LED, which induces a base current in the phototransistor proportional to the light radiated by the LED. This in turn allows current to flow between the collector and emitter of the transistor. A typical LED current is 10 to 50 milliamperes (mA). A 10-mA current greatly extends component life, however.

Generally speaking, optocouplers are not tremendously fast due to the large photosensitive base area and resulting junction capacitance. In solid-state-relay applications, however, speed is not an issue, and it will not present any problems for us. As a matter of education, though, various connection methods for the optocoupler are available, depending upon the excitation signal and response required.

If speed is a consideration, the optocoupler should be connected for

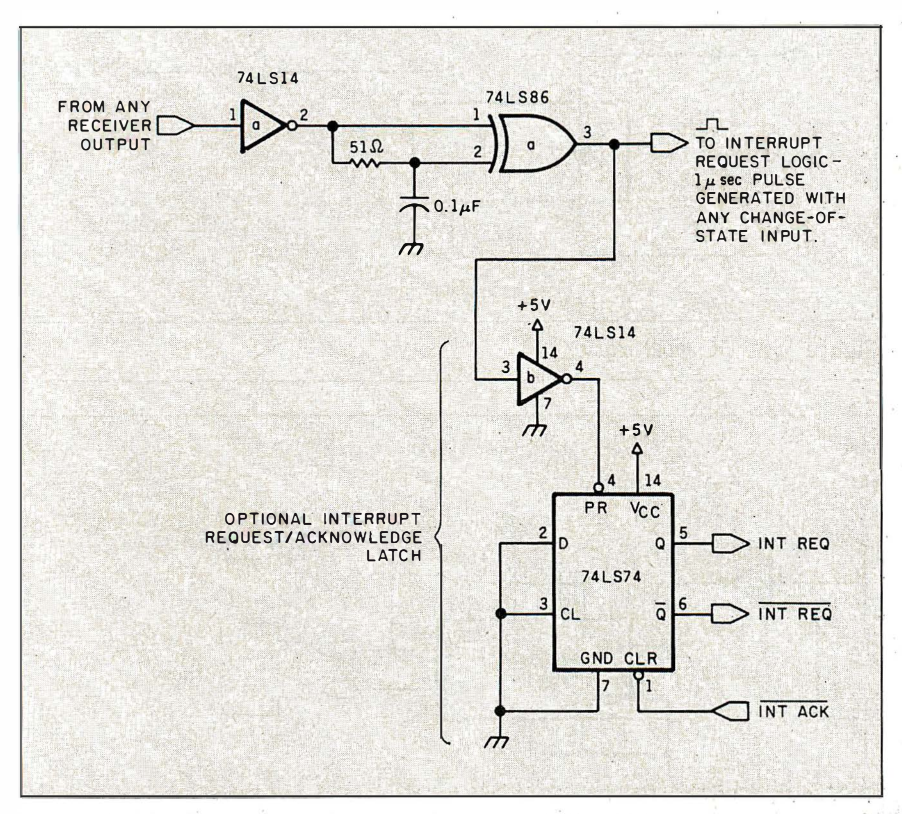


Figure 8: *The change-of-state detector and interrupt-request latch.*

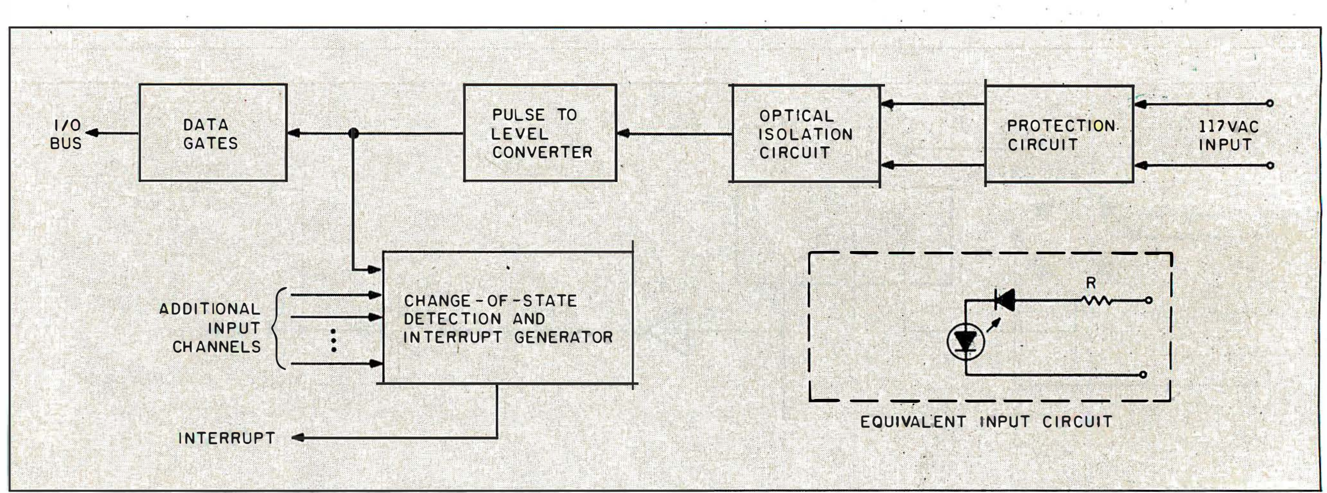


Figure 9: *The block diagram of an optoisolated input circuit.*

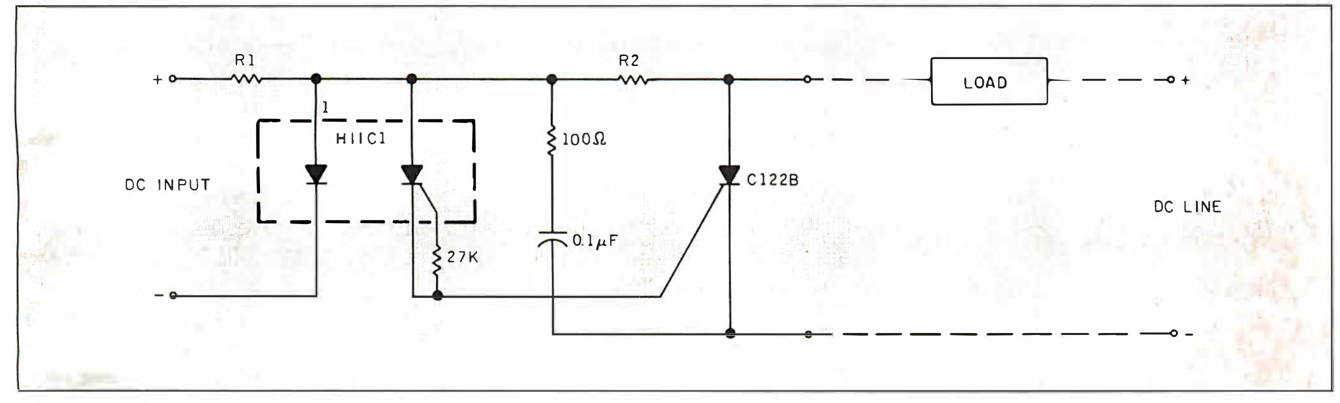


Figure 10: A *simple* DC *output module.*

Table 1: *Resistor values for figure* 10.

DC INPUT VOLTAGE	R1	R2
5	390	200
12	1.1k	200
24	2.4k	470
48	4.7k	1k
120	12k	2.2k

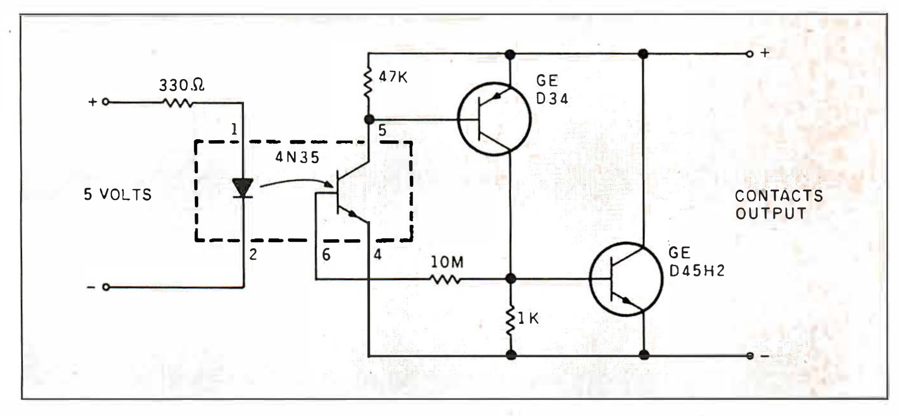


Figure 11: A *normally open* DC *output module.*

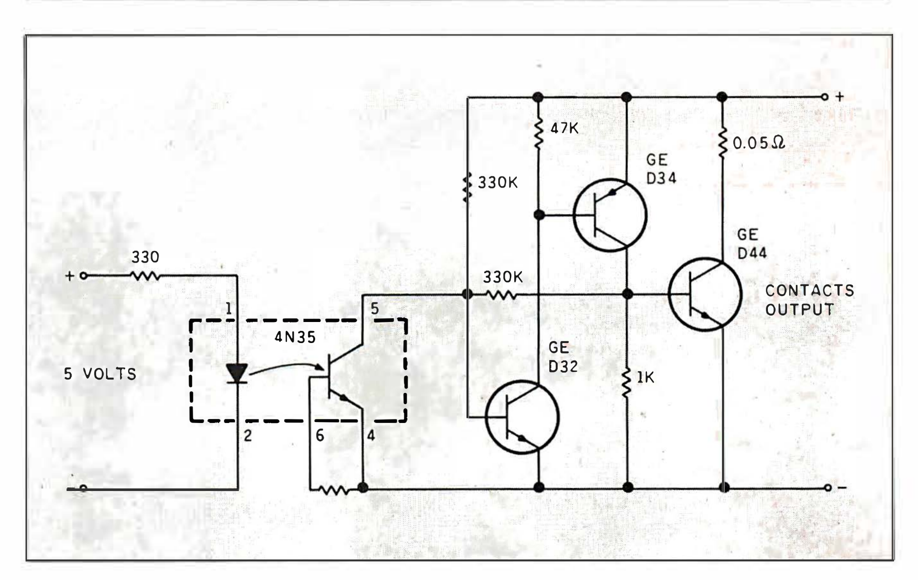


Figure 12: A *normally closed* DC *output module.*

diode-diode operation, as in figure 2. The output signal is directly received at the base connection. Typical response time is 2 to 5 microseconds (μs) as a diode-transistor coupler but only 50 to 100 nanoseconds as a diode-diode coupler. The one disadvantage is the much lower output current, which must be amplified.

While most experimenters think of optocouplers as digital devices, a transistor optoisolator can also be used with analog signals, as shown in figure 3. A constant bias current is applied to the LED to turn the transistor on enough to be within its linear range. Next, an analog input signal (modulation voltage) is also applied to the LED, which varies its light output proportionally to the modulated input. The emitter current in the phototransistor similarly follows this variation.

Most optocouplers are used for digital isolation, as shown in figure 4. A 10-mA LED current simply turns the transistor on or off with the inverted and noninverted responses available at the collector and emitter, respectively.

While the transistor optocoupler is the one I've chosen to describe, optocouplers are available with transistors, silicon-controlled rectifiers (SCRs), and Triacs as output devices. In some applications, the latter devices are more appropriate.

Discrete-Input AC/DC Receivers

The discrete-input DC receiver is by far the easiest module to construct. As demonstrated in figure 5, it is nothing more than an LED and a current-limiting resistor. I have added a series-blocking diode to protect the optocoupler from reverse connection and a 74LS14 Schmitt trigger to provide cleanly switched levels to the computer.

DC input receivers are generally preset as 5-, 12-, 24-, 36-, or 48-V detectors. The series-input resistor

(continued)

Due to the sinusoidal properties of the signal, acquiring AC inputs is somewhat more complicated.

sets the range, which is selected to allow a current of 10 to 20 mA through the LED at the desired DC sense point. While various input-protection methods exist, the resistor should be selected for a single high-level input rather than a range of inputs. When the input is at the desired input voltage, the output will be an LSTTL (low-power Schottky transistor-transistor logic) logic 1; otherwise, it will be a logic 0.

Due to the sinusoidal properties of the signal, acquiring AC inputs is somewhat more complicated. Unlike relays, which are too slow to be seriously affected, optocouplers are fast enough to respond to every cycle of the input producing a pulse rather than a constant-level output. Proper reception by an even faster computer requires that these signals be integrated to an on/off steady-state level, as described in figures 6 and 7. Figure 6 is a half-wave detector that uses a 30-millisecond (ms) retriggerable one-shot; figure 7 is a full-wave detector that employs a simple RC (resistor-capacitor) circuit to integrate the pulse output. In either case, a logic 1 output signifies that a 115-V AC input is present.

Change-of-State Detection

One infrequently mentioned but important issue regarding discrete-input receivers is change-of-state detection. "Change of state" means simply that a receiver has changed its input level since the last time you looked at it. This might seem trivial if you have only one input module but is quite essential if you are monitoring 64 devices.

The change-of-state condition can be determined and indicated either through hardware logic or software programming. Figure 8 is a hardware change-of-state detector. Whenever the input module's level goes from 0 to 1, or 1 to 0, a 1-μs pulse is generated at the output of the 74LS86 exclusive OR gate. This signal can be used to directly interrupt the processor or set a change-of-state flip-flop, as shown. The flip-flop retains its set condition until reset by the interrupt program. If eight input modules are used, there would be eight sets of this hardware with the outputs combined to generate a single "someone changed" interrupt. Figure 9 diagrams this approach. The advantages of the hardware change-of-state detection are that it is transparent to the user and requires little processor overhead.

An alternative approach is to scan the inputs in software periodically and compare the old and new readings to find changed states. In sophisticated control systems, a background interrupt routine periodically scans the in-

115VAC
+ AC SOLID-STATE RELAY – AC
3-25V
LOAD
150Ω 180Ω 2.4K
+ AC
1N4002
1 6 MOC3011
2N6071B TRIAC
0.1µF 400V
3-25V CONTROL INPUT
115VAC
2 4
2N2222
47Ω
10K
– AC

Figure 13: A *discrete-component non-ZVS solid-state relay.*

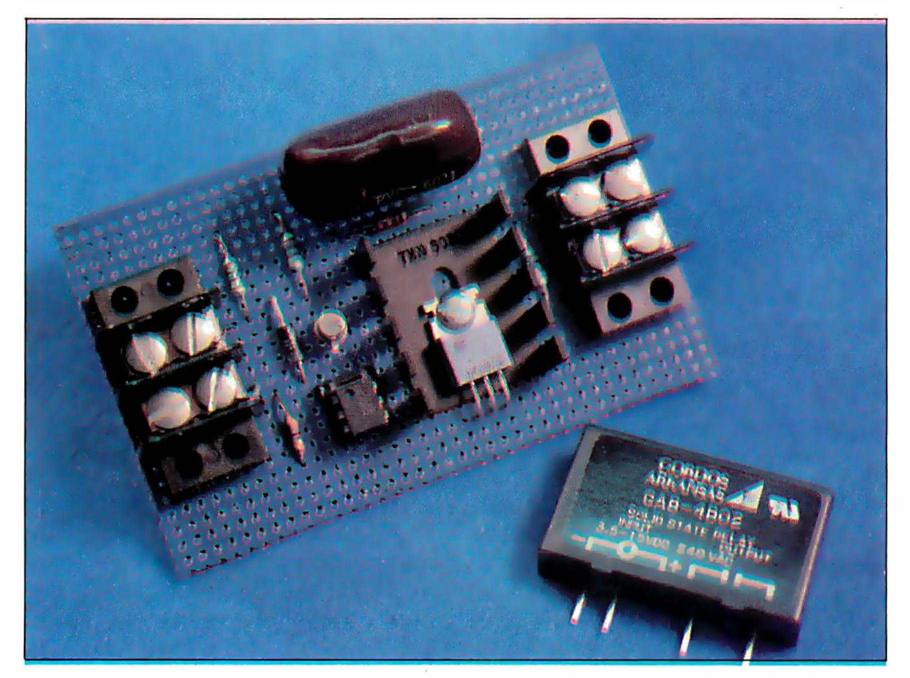


Photo 1: *The circuit board is a prototype of a typical non-ZVS solid-state switch like the one described in figure 13. A simpler alternative is to use the solid-state relay shown to the right of the board.*

put channels. Any changed states are represented as a byte in a table available to the application program. More on this technique later in our real application.

DC Power Output Control Devices

As previously mentioned, mechanical relays have been and can still be used in power-control applications. In new designs, however, the cost-effective approach is to use SSRs.

Solid-state relays come in a variety of flavors, depending upon the application. Unlike mechanical relays, which are nonpolarized, SSRs can be either polarized or nonpolarized. DC SSRs are normally polarized; AC SSRs are not.

Figures 10, 11, and 12 illustrate three kinds of DC output control modules. While they technically are SSRs, polarized switches such as DC output control modules are quite different in component configuration and are generally referred to as DC output units rather than SSRs. Figure 10 is a very simple DC module using an *H11C1* photo SCR, which in turn triggers a higher-current SCR. Because it uses an SCR, this type of circuit simulates a latched-output relay. A voltage level applied to the LED input turns on the SCR and allows current to flow through it. The amount of voltage that will turn on the SCR is determined by R1 and R2, as shown in table 1. Both the LED input signal and the external load current must be removed to turn off the SCR.

This seems to be an absurd situation if the purpose of the DC output module is in fact to control the external current. Because of this, SCR relay devices are not normally used for DC resistive loads and are reserved in-

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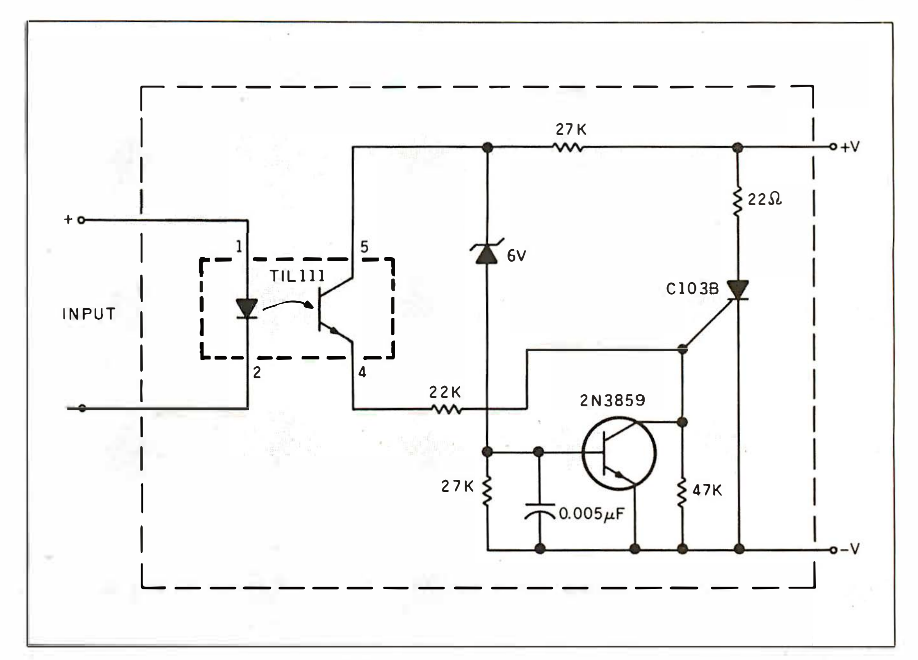


Figure 14: A *normally open* ZVS *circuit.*

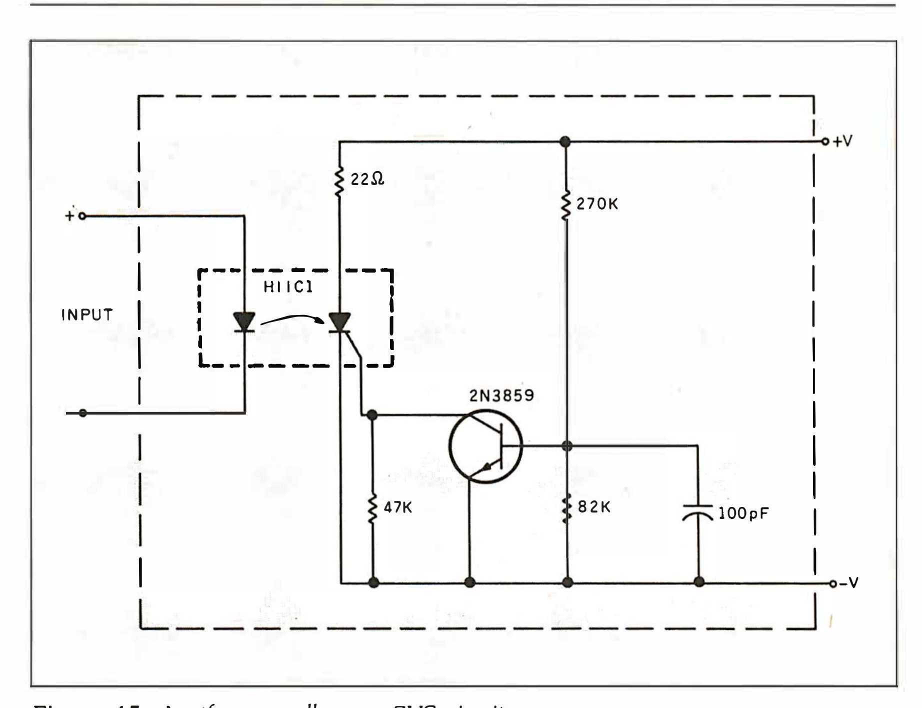


Figure 15: A*nother normally open* ZVS *circuit.*

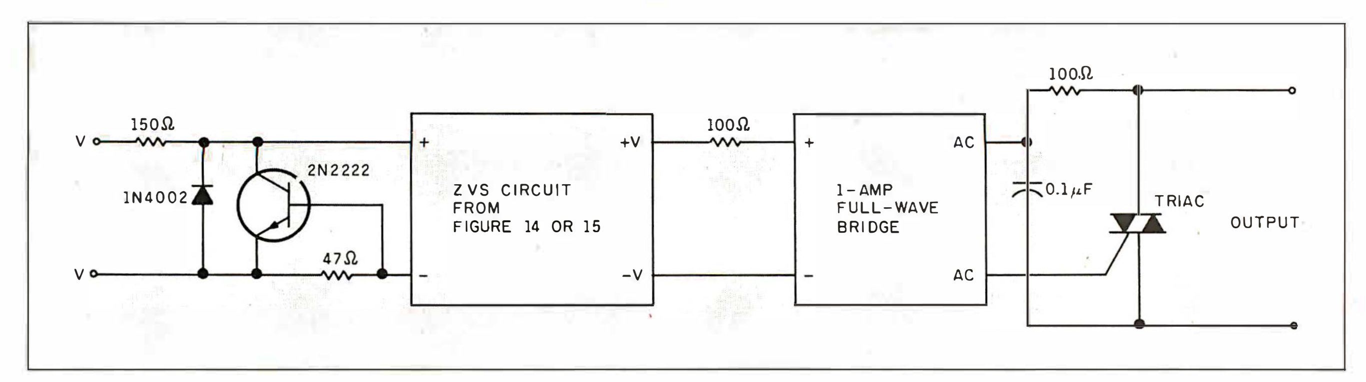


Figure 16: A ZVS *stand-alone* SSR.

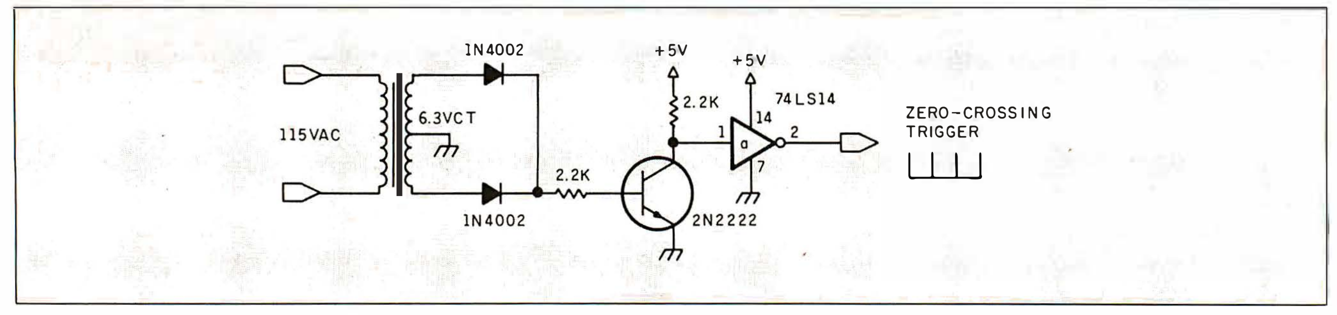


Figure 17: *An isolated zero-voltage sensor.*

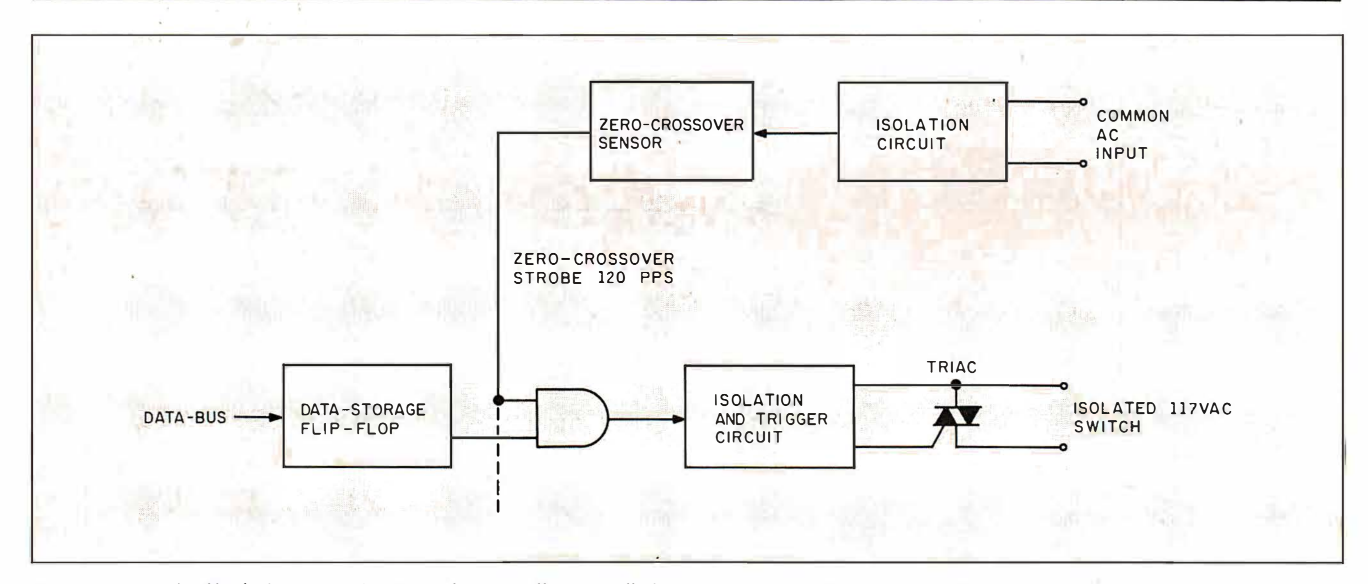


Figure 18: *The block diagram of a typical externally controlled zero-crossover* AC *output circuit.*

Figure 19: *The typical computer-controlled* SSR *output with* ZVS.

Figure 20: *Mounting-connection diagrams of four Gordos Arkansas power I/O interface modules.*

stead for commutating loads such as motors. With a DC commutating motor, the output current is interrupted many times a second as the motor shaft turns, allowing the SCR to turn off when the LED is extinguished.

All other DC control applications rely on transistor control elements, which exhibit fewer peculiarities but involve more components. Figures 11 and 12 demonstrate two typical 25-V DC output-module designs. Figure 11 is configured to have a normally open output; figure 12 has a normally closed output. These units are nonlatching and can be turned on or off in direct response to the logic levels from a parallel output port.

AC Power Output Control Devices

When we use the term "solid-state relay," we are generally talking about AC power output devices. These SSRs are nonpolarized and intended for

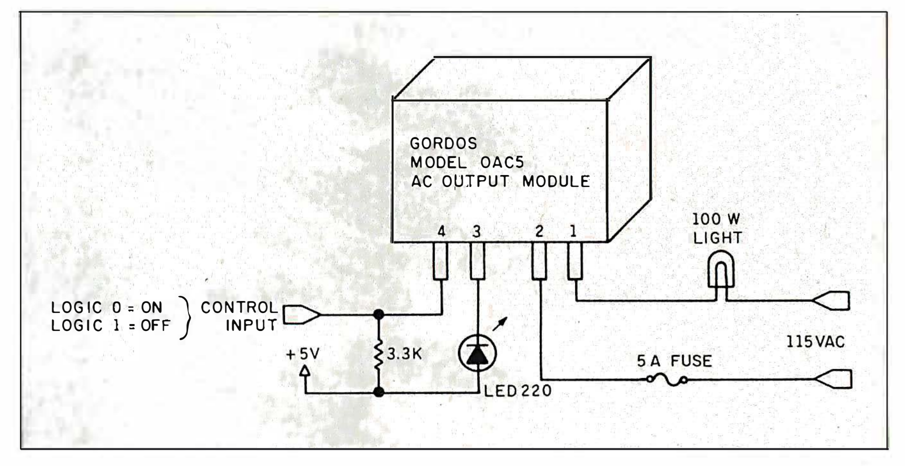


Figure 21: *The connections for a Gordos AC output module.*

use only with AC loads.

Figure 13 and photo 1 show the circuit of a general-purpose off-the-shelf component-configured SSR module suitable for control of lights and light-load appliances. The circuit employs an MOC3011 photoisolated Triac that in turn controls a power-output Triac. Input-protection circuitry has been added to the LED side of the module so that it can be used within a 3- to 25-V input range. (This input circuit can be added to any of the opto-

(continued)

isolators. However, if it is going to be attached only to a computer's parallel output port, you can dispense with this extra circuitry and use the simple resistor-input configuration of figure 9.) The additional resistors and capacitors form a "snubber" network that dissipates the transients produced when the Triac is connected to inductive loads.

As with any relay function, line transients are produced when a voltage is suddenly applied to an inductive load. While snubber networks, varistors, and transient suppressors offer some relief, the solution is to minimize the cause. If the Triac or SCR can be turned on only when the load voltage is at or near zero, no transients will be produced. The circuit that senses this condition is a zero-voltage switch (ZVS) or zero-crossover trigger network.

The ZVS may be built into the individual SSR (increasing its cost considerably if done with discrete components) or applied as a synchronous trigger to noninternal ZVS solid-state relays. Figures 14 and 15 are opto-isolated discrete-component zero-voltage switches that, when individually combined with the circuit in figure 16, produce a stand-alone ZVS output relay. Generally speaking, most commercial relays contain internal ZVS switching to improve performance. To keep costs down, these SSRs are constructed using hybrid technology rather than discrete components.

If you are building an AC I/O interface with commercial modules that include ZVS, it need be of no further concern. If you are building this interface from scratch, however, you can either build each relay module with internal ZVS or provide an external ZVS signal that is routed to an AND gate along with the control signal from the computer and applied to a non-ZVS switch, such as the one in figures 14 and 15. A circuit that detects zero crossing is demonstrated in figure 17, and a block diagram of this synchronous switching concept is presented in figure 18.

Figure 19 is the circuit for a computer-controlled AC output interface using the devices I've described thus far. To turn on the individual output channels, you merely set a logic 1 output at that bit position. This is most easily accomplished with an OUT command in BASIC. Once the bit is set, the SSR will turn on at the next zero crossing of the AC line.

Not Through Yet

Ordinarily, the project would end here. I've demonstrated how to build the I/O modules. A two-line BASIC program with INP and OUT instructions is all that it takes to control them. Unfortunately, knowing how to build a solid-state relay is different from assembling a practical control system.

Rather than leaving these practical matters as an exercise for you, I'd like to describe the 64-channel power I/O

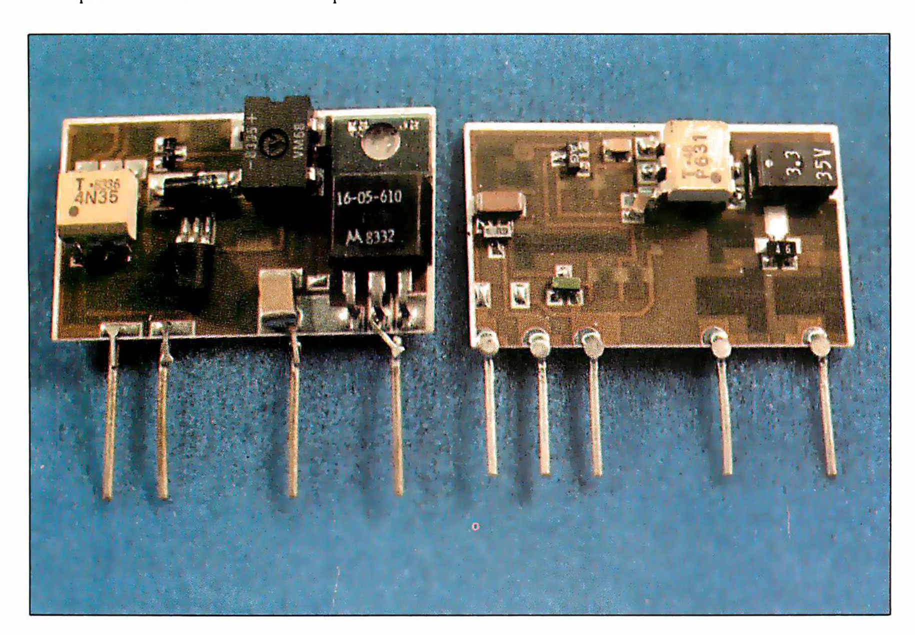


Photo 2: *The commercial I/O modules used in this project are hybrid circuits containing laser-trimmed resistors as well as discrete and integrated components. Two Gordos Arkansas Inc. modules are shown unpotted to demonstrate their complexity. The module on the left is an* AC *output (type* OAC 5) *and the unit on the right is an* AC *input (type* IAC 5).

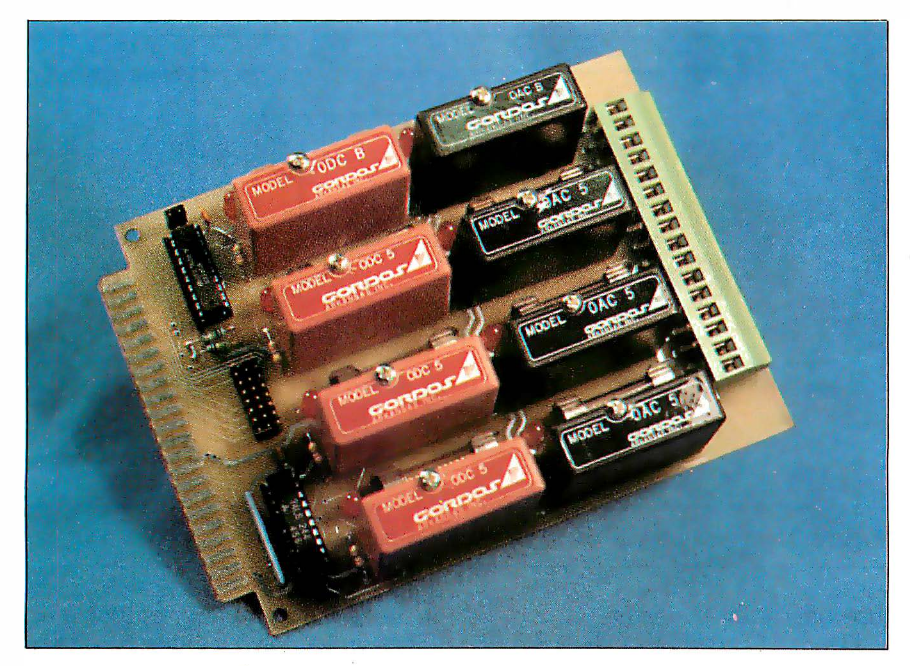


Photo 3: *Eight of these I/O modules can be mounted together on a single board. Individual boards can be separately configured as* AC-DC *output or* AC-DC *input. The* Circuit Cellar Z8 Power I/O *prototype board in the photo has four* AC *outputs (black modules) and four* DC *outputs (red modules).*

system I ultimately configured. The description, though somewhat complex in detail, is intended to provide a basic understanding of the system software necessary to implement a reliable high-performance industrial-grade closed-loop control system. Utilizing the basic concept but substituting commercially available power I/O modules and a dedicated computer, a rather sophisticated programmable power I/O control system can be configured.

The commercial modules I chose are made by Gordos Arkansas Inc. Shown in photo 2, these potted modules are designed using thick-film hybrid technology for high-density packaging. Figure 20 is a diagram of the contents and connections of four typical Gordos power I/O interface modules. Figure 21 demonstrates the physical connections for an AC output module.

The computer I chose is the Z8 system/controller, which I've used in many Circuit Cellar projects. Based on a project presented in July and August 1981, the Z8 system/controller is a 4- by 4½-inch single-board computer with on-board tiny BASIC or FORTH, 6K bytes of RAM (random-access read/write memory) or EPROM (erasable programmable read-only memory), two parallel ports, and one serial port. To the Z8 computer, I've added the Micromint BCC33 memory and parallel I/O expansion board, which adds 8K bytes of memory, three parallel ports, and a cassette-storage interface, to interface to the power I/O modules.

(If you have either built the original Z8 computer/controller and wish to update it to the system/controller configuration or would like to build the memory and I/O expansion board for your existing system, just send me a preaddressed 9- by 12-inch envelope with $2.30. postage |overseas, just send name and address and $4 in international mail coupons| and I will send you the schematics and manuals for the two boards.)

The three parallel ports on the expansion board are configured as an I/O bus with input, output, and control capability. The power I/O modules are separated by function (input or output) and arranged eight modules per I/O card. Both AC and DC modules may be on one card, but only if they are all the same function. Up to 16 boards (64 input and 64 output modules, addressed as input boards 0 through 7 and output boards 0 through 7) can be accommodated with a single BCC33 expansion board. (Eight expansion boards can be put in the system if you are trying to control a small city.)

The computer communicates with the I/O cards through the expansion-board parallel ports. Port A functions as an 8-bit input bus, port B as an 8-bit output bus, and port C as the control lines for the individual I/O cards. Each power I/O card has a set of eight two-position jumpers, a 74LS374 output latch, and a 74LS244 input buffer (see photo 3 and the schematic in figure 22). Photo 4 shows some of the cards mounted in a card cage.

A single jumper selects board address and function. The eight output lines of port C are attached to the center position of the eight jumpers (boards 0 through 7). Only one of these lines is active low at a time; all others are at logic 1. The line that is low enables the power I/O card jumpered to it. Within that enabled card, a jumper installed to the center and left side (O) will enable the LS373. If installed between the center and the right side (I), it selects the LS244. A second jumper Tri-states the LS373 when the board is configured for input. If the jumper were in the #31 position, this would be addressed by bit 3 on port C, and it would be an input-only card.

The process of interfacing with the power I/O cards is relatively simple and can be accomplished directly in BASIC if speed is not a critical factor.

Figure 23 shows a detailed block diagram of the power I/O system. It can be all AC input, DC input, AC output, DC output, or a mixture (in groups of eight similar functions). When you want to set the eight output modules on board 2, you merely set the bit pattern on port B and then strobe bit 1 on port C (board 2 enable line) to latch that data into the LS373. Conversely, to read the eight input channels on board 3, you would set bit 3 of port C low, read and store the data input to port A, and set bit 3 of port C high again.

The process of interfacing with the power I/O cards is relatively simple and can be accomplished directly in

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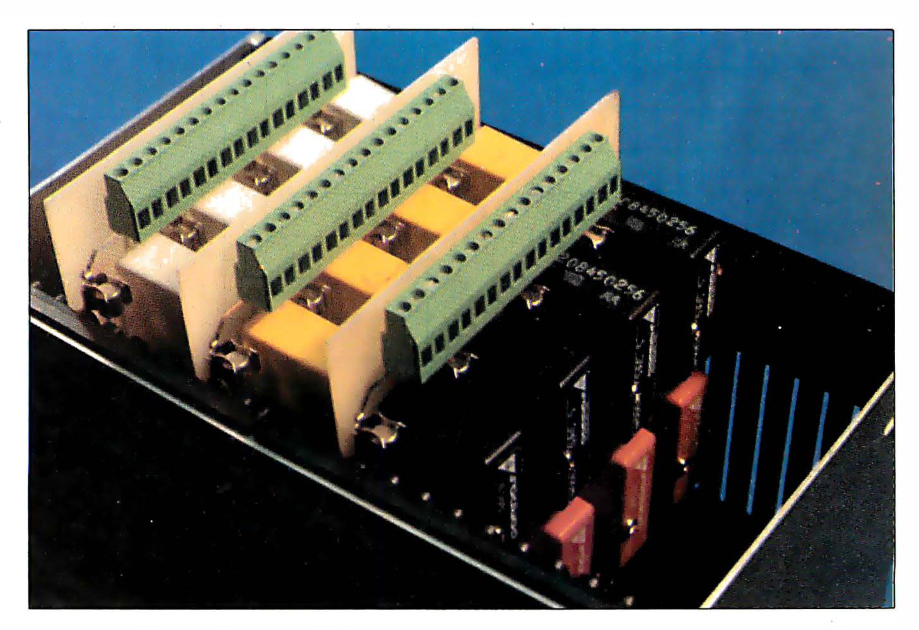


Photo 4: *Up to 16 boards (8 input and 8 output) can be supported from each I/O expansion board in a Z8 system. Up to 4 expansion boards can be mounted in a card cage. The photo shows 3 expansion boards installed. The green connector protruding out of the cage is for external wiring connections.*

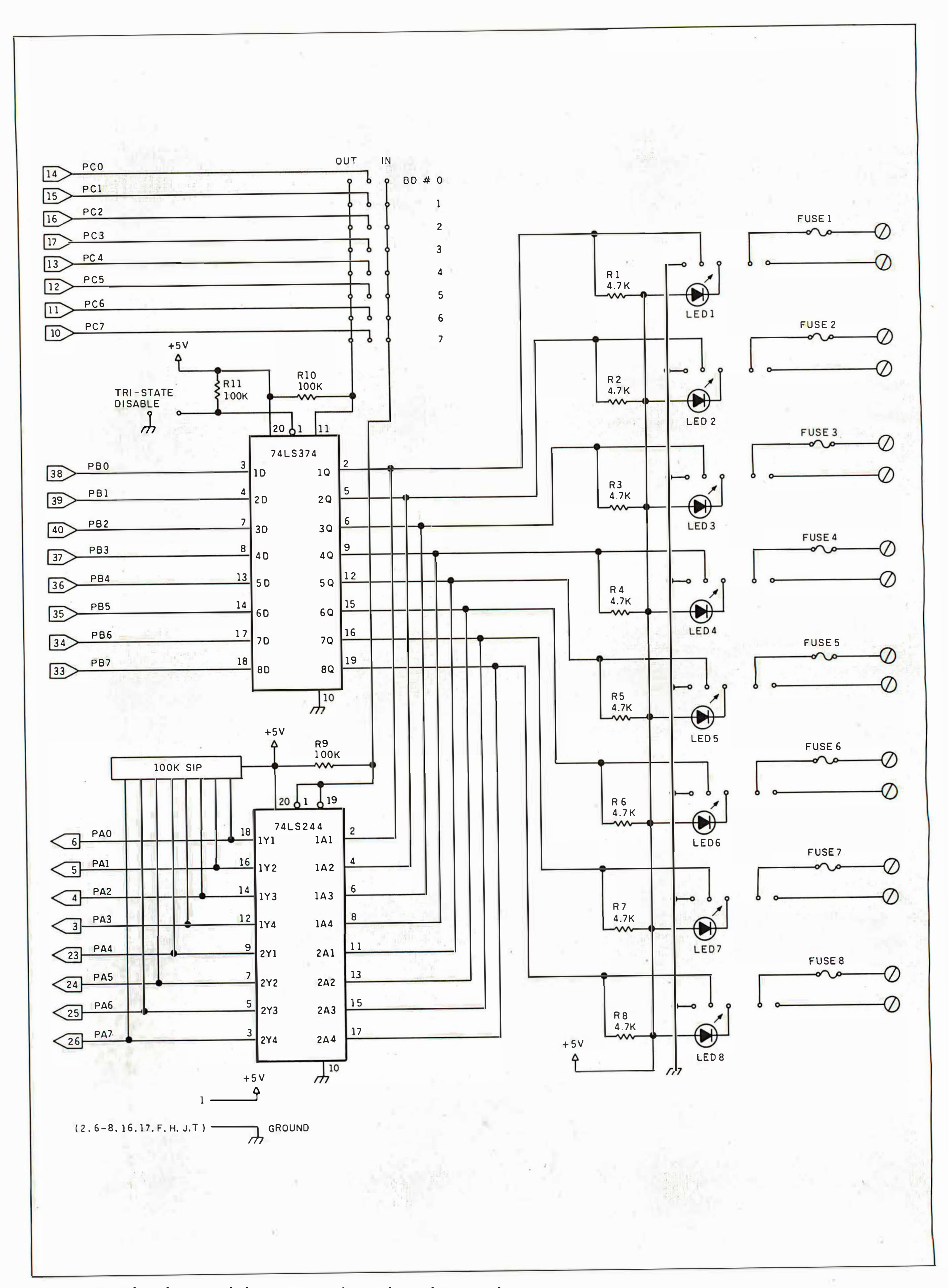


Figure 22: *The schematic of the Z8 power I/O card, as shown in photo 3.*

BASIC if speed is not critical. With 8 or 10 modules, it is not a problem to scan and record change of state, read the real-time clock, and still meet the requirements of the application.

While the simplified hardware for the power I/O system is important, it takes more to produce an industrial-grade control system. It is counterproductive to run time-consuming, repetitive tasks in BASIC that can be done more quickly in assembly language. For that reason, I've added a set of interrupt-driven utilities that greatly simplifies the interaction between user and power I/O system and allows the use of BASIC (unless you prefer assembly language), even with 64 active I/O channels.

These Z8 assembly-language routines, flowcharted in figures 24 and 25, operate as background tasks to any user application programs and are completely transparent. In addition to real-time clock functions, they allow the user to interact with the I/O system through a table of 64 input and output values rather than setting and reading expansion ports. To turn output channel 16 on, we simply load a value greater than 0 into table location 16. To turn output channel 1 off, we load 0 into table location 1.

Conversely, all inputs are continuously scanned and the present values loaded into a similar channel table for examination. In addition to the present value, a separate indication of change of state by board and channel number is also produced. The change-of-state indication is maintained until the user reads the affected channels. The result is a simple BASIC single-byte read-and-compare to find any input channels that have changed and a single-byte write to make a corresponding control output.

The user can drive seven subroutine calls in dealing with the power I/O system. They are

1. System initialization.
2. Read an input channel's change-of-state flag (1 bit).
3. Read an input channel's data bit and reset change-of-state flag.
4. Set an output-channel data bit (1 on or 0 off).
5. Read an input board's change-of-state flags (8 bits).
6. Read an input board's data bits and reset change-of-state flags.
7. Set an output board's data word (8 bits, 1 on or 0 off).

In addition to these subroutines called by the user, other routines under interrupt control update the clock/calendar values and the power I/O boards and data/change tables.

By the time you read this, the Circuit Cellar could be rewired. But I might experiment with my new home-control system.

The completed software fits on a 2716 EPROM on the I/O expansion board. Unfortunately, I don't have room enough here for a complete program listing, but I will send you one if you write to me.

In Conclusion

What started out as a very simple solid-state-relay project got a little carried away. I use all the devices I design, and this is no exception. By the time you read this, the Circuit Cellar could be completely rewired. On the other hand, I might wait a month and experiment a little more with the new Circuit Cellar Home Control System that's in the works. Com-

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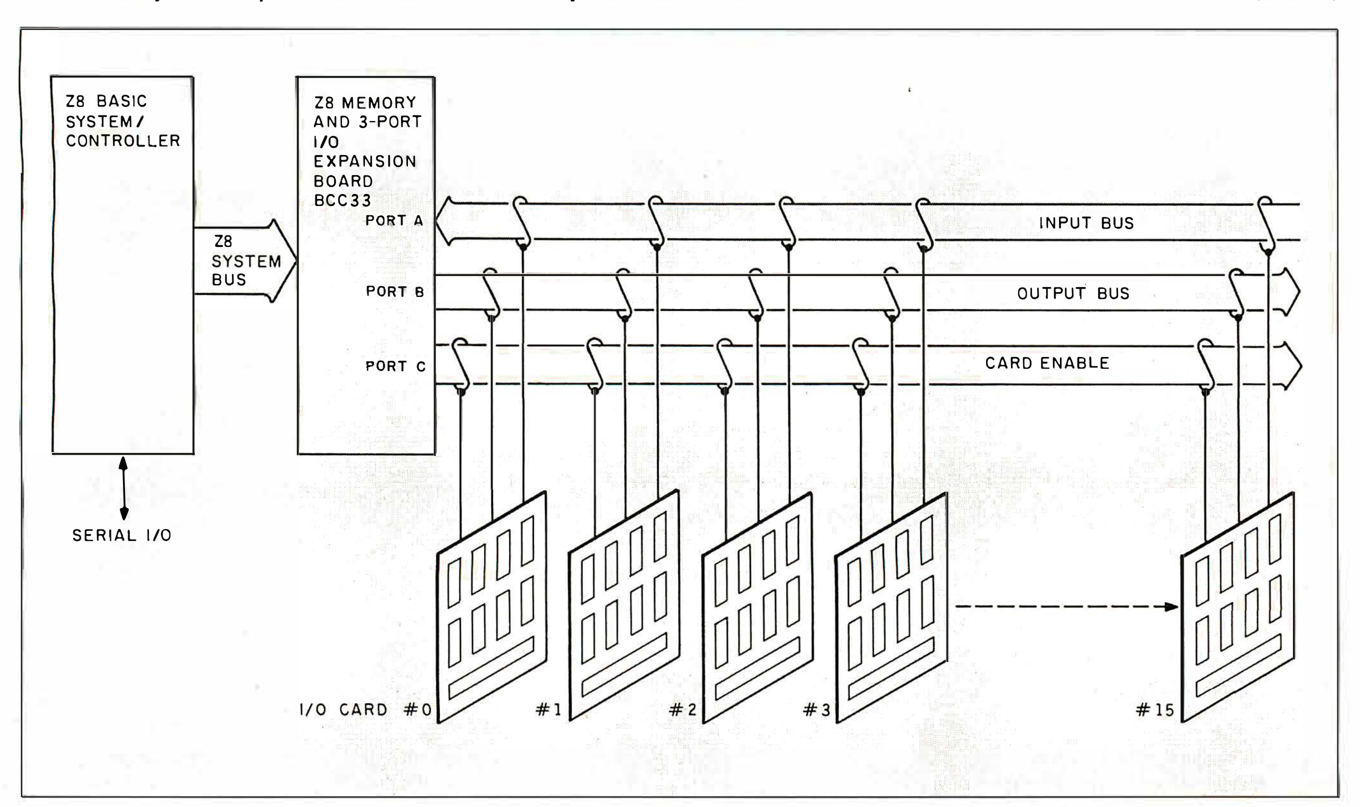


Figure 23: *The block diagram of the Z8 power I/O system.*

INITIALIZE
SET UP TABLE AND HARDWARE POINTER REGISTERS
INITIALIZE Z8 EXPANSION-BOARD CONTROL PORT
CALL ACI/O BOARD UPDATE ROUTINE TO READ/WRITE BOARDS
FORCE ALL CHANGE STATUS BITS HIGH
STORE INTERRUPT-VECTOR ADDRESS
LOAD COUNTERS AND THEN LOAD/START T1 CLOCK
MASK ON INTERRUPTS
EXIT

INTERRUPT
DECREMENT ACI/O COUNT REGISTER
=0 ?
NO
YES
PRELOAD ACI/O COUNT REGISTER
CALL ACI/O BOARD-UPDATE ROUTINE
DECREMENT TIME-COUNT REGISTER
=0 ?
NO
YES
PRELOAD TIME-COUNT REGISTER
CALL TIME AND DATE UPDATE ROUTINE
EXIT

Figure 24: A *flowchart of the* Z8 AC I/O *system initialization and interrupt-handler assembly-language routines.*

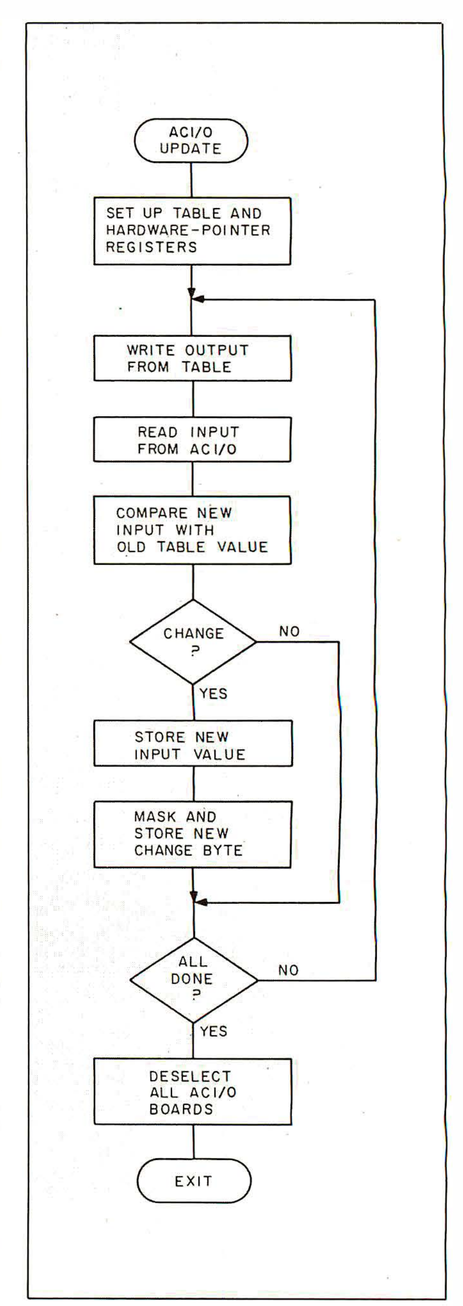


Figure 25: A *flowchart of the* Z8 AC I/O *board update routine.*

puter control fanatics, hold on to your hats, I've just begun.

Circuit Cellar Feedback

This month's feedback begins on page 375.

Next Month

Tired of weak power supplies? Tune in next month, when I talk about linear power supplies. ■

Special thanks to Bill Curlew for his software expertise. Diagrams of Gordos modules reprinted courtesy of Gordos Arkansas Inc.

The following are available from

The Micromint Inc.
561 Willow Ave.
Cedarhurst, NY 11596
(516) 374-6793 for information
(800) 645-3479 for orders

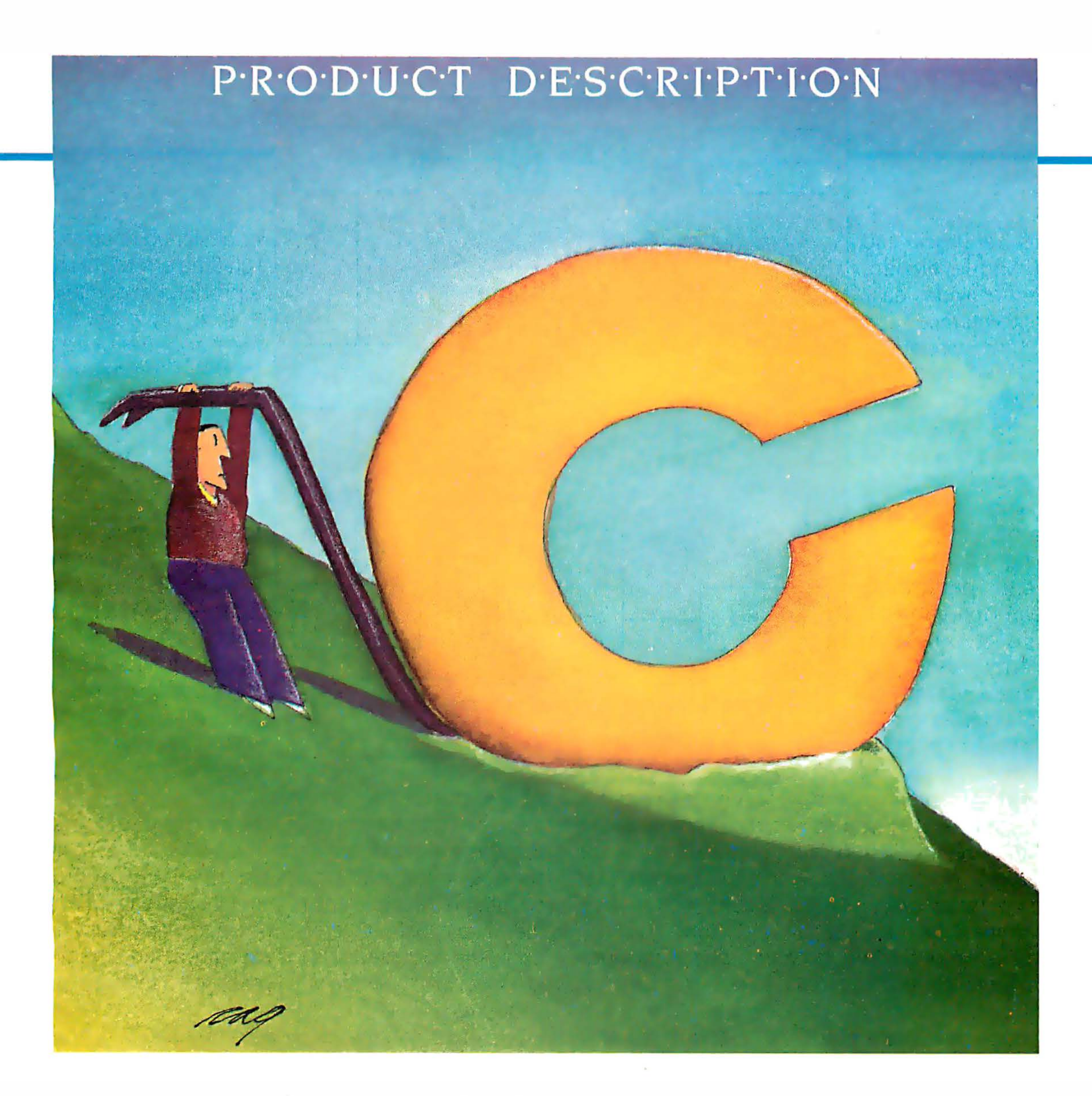
1. Assembled and tested Z8 power I/O board without power I/O modules $159
2. AC input or output modules, types IAC5, IDC5, OAC5, and ODC5 . . . . $15 each
3. Eight-slot motherboard and card cage usable for I/O boards or Z8 . . . please call
4. Z8 system controller $149

Please include $4 for shipping in the continental United States, $10 elsewhere. New York residents please include 8 percent sales tax.

Editor's Note: Steve often refers to previous Circuit Cellar articles. Most of these past articles are available in reprint books from BYTE Books, McGraw-Hill Book Company, POB 400, Hightstown, NJ 08250.

Ciarcia's Circuit Cellar, Volume I covers articles that appeared in BYTE from September 1977 through November 1978. *Volume* II covers December 1978 through June 1980. *Volume* III covers July 1980 through December 1981. *Volume* IV covers January 1982 through June 1983.

To receive a complete list of Ciarcia's Circuit Cellar project kits, circle 100 on the reader-service inquiry card at the back of the magazine.



C–LANGUAGE DEVELOPMENT TOOLS

G. MICHAEL VOSE

Editor's note: The following is a BYTE *product description. It is not a review. We provide an advance look at these new products because we feel they are significant. We plan to provide complete reviews in subsequent issues.*

BASEMENTS AND GARAGES may have been the birthplace of the technology that has evolved into the modern microcomputer, but researchers at one of the world's largest corporations created the C programming language. In the eighties, C has evolved into the software development tool of choice for many serious programmers. Bell Labs' UNIX-driven language has been adapted for use with other operating systems and used to create a multitude of significant personal computer programs, including VisiCorp's Visi On, Microsoft Windows, and the outline processor, MaxThink.

C falls into the mid-level language category—higher than CPU (central processing unit) register- and memory-manipulating, low-level assembly languages but lower than machine-isolating, high-level lan-

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guages like Pascal and Ada. Mid-level languages provide easy access to memory and the CPU while retaining the control and data structures of classic high-level languages. This access enables bit shifting and manipulation using a rich set of operators for incrementing, decrementing, and performing Boolean operations.

While C grew in popularity, many programmers agonized over its complexity and the lack of debugging tools like the monitors for tracking errors in assembly-language programs, utilities that enable you to set breakpoints in the code and use single-step execution. Outside of the UNIX realm, where C debugging facilities are part of the operating system (which is itself written in C), programmers faced a barren landscape.

In microcomputerdom, however, where entrepreneurial fervor thrives, vacuums do not exist for long. Recent months have brought forth a number of new C-language development tools and debugging aids. Many of these tools were created specifically for the microcomputer programmer.

In this product description I'll look at three of these products: the Safe C Compiler and Profiler from Catalytix Corporation of Cambridge, Massachusetts; the Instant-C interpreter from Rational Systems Inc. of Newton, Massachusetts; and the C Source Debugger from Mark Williams Company of Chicago.

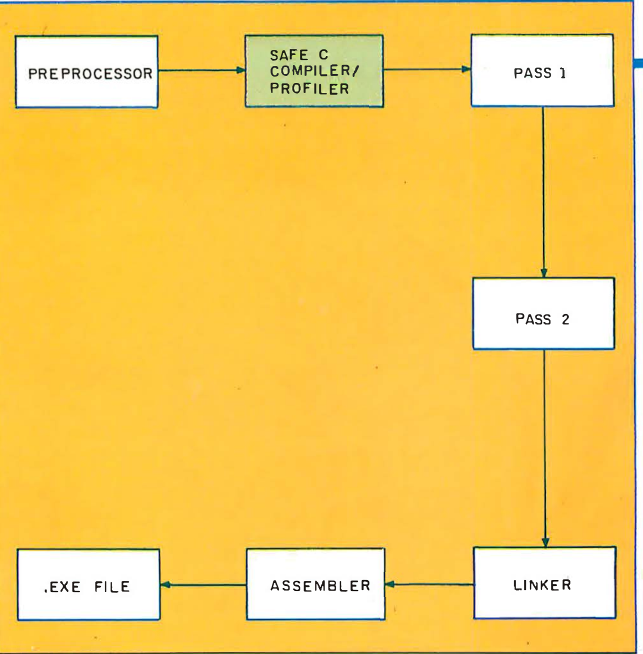


Figure 1: *Adding a preprocessing pass to a typical C compile cycle.*

Safe C Compiler/Profiler

One of the more significant problems a C programmer faces is run-time error detection. Running a C program in the early stages of its life cycle resembles a Cessna pilot trying to land a 747—he might know how to fly but isn't sure which are the right controls.

Unlike Pascal compilers, C compilers do not provide extensive run-time error checks during compilation. C compilers cannot check for array indexing errors, divide-by-zero, and similar run-time errors. C programmers have no tool to verify the correctness of argument data types passed to functions or to detect the existence of a stray pointer. Dangling pointers can cause system crashes on many microcomputer implementations of C.

The Safe C Compiler/ Profiler is a checkout compiler designed to uncover run-time errors. It is not a production compiler; it is simply a development tool designed to increase programmer productivity (while decreasing the programmer's frustration level).

Safe C adds a source-to-source preprocessing pass to the normal C compile cycle (see figure 1). Safe C inserts checkout code into the original source file and then compiles the resulting file. The checkout code swells the original source in size by a factor of two or three.

As the compiler compiles the modified source file, the checkout code prompts the generation of error messages for every possible run-time error encountered. Multiple errors generate a stream of error messages. Safe C error messages are warnings only—the compiled code is executable, and the programmer must decide whether to heed the warnings generated.

The error conditions detected by Safe C include

- out-of-bounds array indexes
- arithmetic overflow and division by zero
- overflow in standard string routines
- mismatch of actual and formal function parameters
- misuse of standard I/O (input/output) routines
- indirection through and stack corruption by stray pointers

The compiler also reports standard syntax errors.

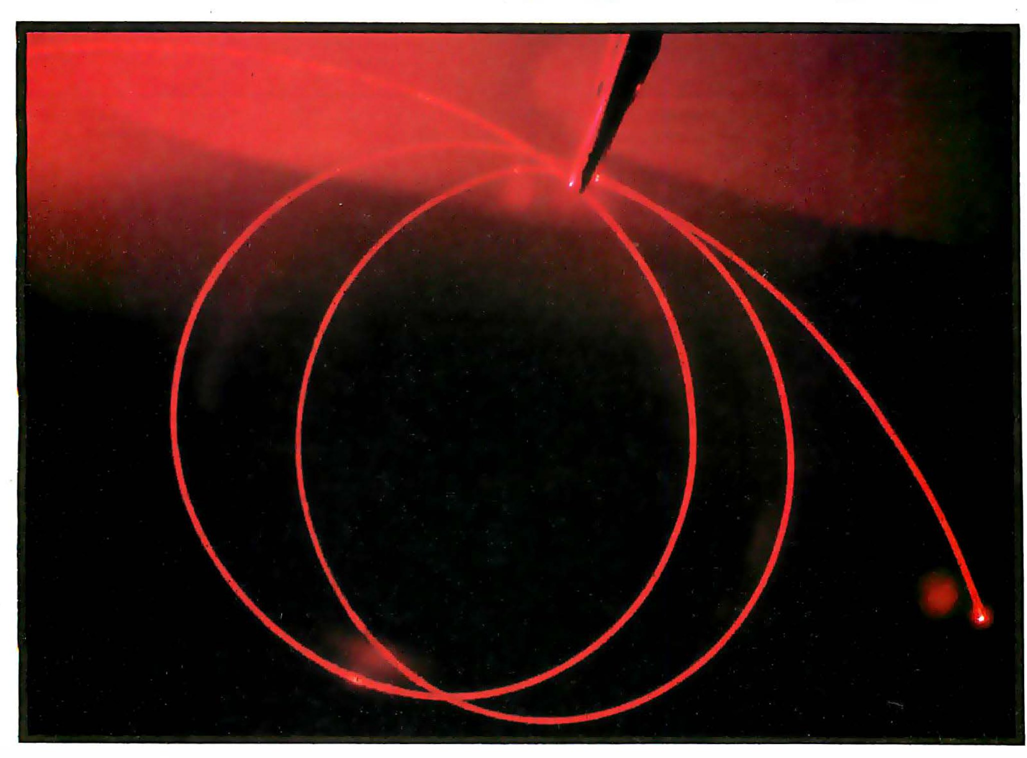
Probably the most important function the Safe C Compiler provides is detecting mismatches in function parameters. C's main strength derives from its modularity. Ideally, C programmers write their programs as small, individual units that are later linked together. The potential for error among the interacting parts is high, mostly due to the passing of arguments of the wrong data type.

The Safe C Profiler is a dynamic software development tool that provides both function and statement execution counts. When a programmer needs to know where a program spends most of its time, the Profiler provides a count of the times a function is called and, within functions, the number of times a

(continued on page 382)

PART I

AN INTRODUCTION TO FIBER OPTICS



Light tamed by glass waveguides offers wide communication bandwidth

BY RICHARD S. SHUFORD

Alexander Graham Bell's many inventions included the photophone. In this device, which he demonstrated in 1880, a beam of sunlight was reflected off a shiny diaphragm mounted on an acoustic horn. The light beam was aimed at a distant selenium photocell connected to a speaker; speech could be understood at a distance of 700 feet.

But the photophone's short-haul line-of-sight communication was practical in few instances, so lightbeam transmissions were shelved for the better part of a century until another field of research caught up and furnished a means whereby information-bearing light could be channeled and directed where it was needed.

In the mid-1960s, C. K. Kao and G. A. Hockham at ITT's Standard Telecommunication Laboratories in England suggested an idea for directing light waves where they were needed. By 1970, scientists at the Corning Glass Works had made the concept work. Pieces of silica glass stretched as thin as a human hair became easily bendable and could serve as practical *waveguides* for light waves—and the field of fiber optics was born. At the same time, semiconductor technology made possible the fabrication of efficient light sources that

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Richard S. Shuford is BYTE's *special-projects editor. He can be contacted at* POB 372, *Hancock,* NH 03449.

PHOTOGRAPH © CHARLES FALCO / SCIENCE SOURCE, PR

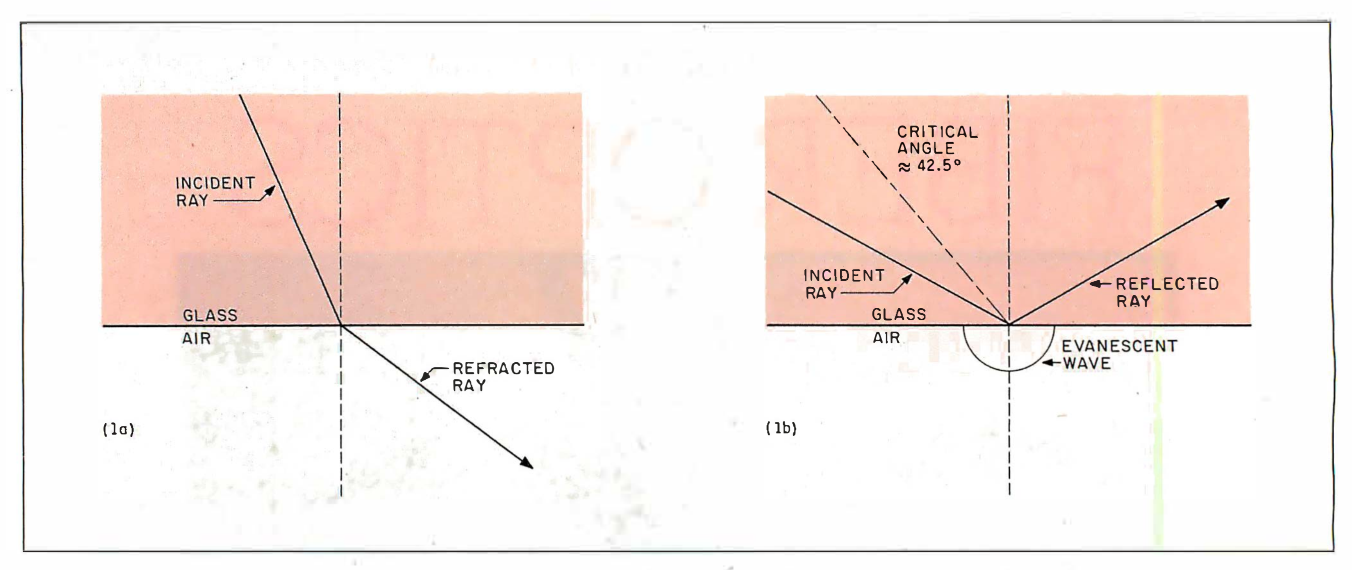


Figure 1: *When a ray of light hits the boundary between two media with different indices of refraction, one of two things can happen. In figure 1a, where the angle of incidence is rather steep, the path of the ray is bent as it enters the second medium. But in figure 1b, the angle of incidence is below the critical angle, so the beam is reflected back into the first medium.*

$n_1 \approx 1.470$
$n_2 = n_1(1-\Delta)$
$\Delta \approx 0.01$

$n_1 \approx 1.470$
$n_2 = n_1(1-\Delta)$
$\Delta \approx 0.01$

$n_1 \approx 1.460$
$n_2 = n_1(1-\Delta)$
$\Delta \approx 0.002$

REFRACTIVE INDEX PROFILE

CLADDING
CORE
n_2
n_1
TYPICAL 50μm
TYPICAL 125μm

TYPICAL 50μm
TYPICAL 125μm

TYPICAL 10μm
TYPICAL 100μm

STEP-INDEX MULTIMODE FIBER
(2a)

GRADED-INDEX MULTIMODE FIBER
(2b)

SINGLE-MODE FIBER
(2c)

Figure 2: *The three types of optical fibers. The step-index multimode fiber (2a) has a sharp transition of refraction index n at the core/cladding boundary. The graded-index multimode fiber (2b) features an index that gradually changes across the axis of the core. The single-mode fiber (2c) has a much smaller core that supports the propagation of only a single ray of light moving along the core's axis.*

could be modulated with an external signal.

Fiber Optics: Pros and Cons

The greatest attraction of fiber-optic technology is the bandwidth of light transmission. Light in the visible and near-visible spectrum has characteristic frequencies so high that they are rarely discussed as such: hundreds of gigahertz (GHz), or billions of cycles per second. According to theory, a carrier wave composed of these high frequencies can transmit meaningful information at a tremendous rate; the Nyquist limit for the fastest-changing signal a carrier wave can convey in a perfect medium is one-half of the carrier's frequency. Light, tamed by a fiber-optic waveguide, offers the great communication capacity modern technology increasingly demands.

Optical fibers have other good qualities. The wide bandwidth is accompanied by low loss, compared with metallic media. Fiber-optic cables are immune to interference from electric and magnetic fields; a fiber can be installed in an electrically noisy engine room without shielding. Conversely, no radiation escapes the fiber cable to interfere with its environs. Fiber-optic links may be tested in highly accurate ways that can locate imperfections, including any surreptitiously installed taps in networks carrying confidential data. The nonconducting fiber never plagues electronic equipment with voltage leaks or ground-current loops—in fact, you can think of the fiber-optic link as just an extremely long optoisolator. Furthermore, fiber cables are small and lightweight and fit where copper wires won't.

But there ain't no such thing as a free lunch. Optical fibers do have some disadvantages.

The most obvious drawback lies in the physical handling and installation of fiber-optic cables. The techniques for dealing with a communication channel made of glass differ radically from those for dealing with copper wire; a technician skilled in soldering conventional coaxial cables may blanch when shown the unfamiliar tools used to splice and install connectors on optical fibers. And the connectors themselves come in bewildering, proprietary variety (although a few standards are emerging).

Another drawback is the complex interface equipment fiber-optic cables require to make use of all that bandwidth. The circuitry that forms the "funnel into the fiber" must operate in two discrete realms: electronics and photonics. It must be of high quality for the most efficient transfer of the signal and must compensate for the quirks that appear in any apparatus that blends two kinds of technology. The simplicity and economy of the fiber-optic waveguide itself are offset to some degree by the expense of the interface equipment.

But because fiber optics is a new field, researchers are making rapid progress in solving or reducing the seriousness of the problems involved, and costs are being driven down. Fiber-optic cables have already shown their cost-effectiveness in long-distance telecommunication applications, where their low loss enables telephone companies to employ fewer repeaters over long, continuous runs than with conventional cables. And certain other applications that demand one of the qualities at which optical fibers excel have also reached the break-even point in competition with copper.

Fiber-optic communication is now finding its place in computer systems, especially in wideband links within multiprocessor arrays and in high-performance or high-security distributed networks. And even small-scale microprocessor-based equipment can use optical fibers to good advantage because of their immunity to interference.

How Optical Waveguides Work

In an optical fiber, light goes in one end and comes out the other, no matter how many twists and turns the fiber makes along its length. This defies our everyday experience that light travels in straight lines. The fiber can perform this feat because its designers have carefully applied a phenomenon that is a cousin to refraction: total internal reflection.

Refraction occurs because light moves faster through some materials than through others. (It moves at its well-known 186,280 miles-per-second speed only in a vacuum.) In the simple case of a glass-to-air interface, a light wavefront within the glass (represented in figure 1 in simplified form as a ray) approaching the boundary at a relatively steep angle has its direction changed as it suddenly encounters a region where it can travel at a faster speed. The amount of change in the refracted angle varies as a function of the incident angle up to a certain *critical angle* (about 42.5 degrees for glass/air). If the angle at which the incident ray approaches the boundary is lower than this critical angle, the light is *reflected* back into the glass at an angle of reflection equal to the angle of incidence.

An optical fiber consists of a cylindrical inner *core* and an outer concentric shell, the *cladding*. (The cladding is usually enveloped by protective outer layers, but these play no functional role.) The core is made of transparent glass (or sometimes plastic) with a relatively high index of refraction; the cladding, of glass with a relatively lower index. Light enters from one end, and internal reflection occurs at the core/cladding interface, just as at the glass/air boundary in the example, letting the light emerge from the other end as if the fiber were a pipe. (A typical core/cladding critical angle is 8.5 degrees.)

Types of Optical Fibers

Optical-fiber waveguides are made in two major classifications, one of which is subdivided into two varieties. The major division is between fibers that convey light in single or multiple modes, where a mode can be thought of as a group of rays bouncing through the waveguide at a given incidence/reflectance angle. The multimode fibers are differentiated by the profile of the refraction index across the fiber's diameter.

Figure 2 shows the three kinds of fibers. The *step-index multimode* fiber (2a) features an abrupt transition of refraction index at the core/cladding boundary. The *graded-index multimode* fiber (2b) exhibits an index of refraction that reaches a peak in the center of the core and gradually tapers off to

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BY GREGG WILLIAMS

SOFTWARE FRAMEWORKS

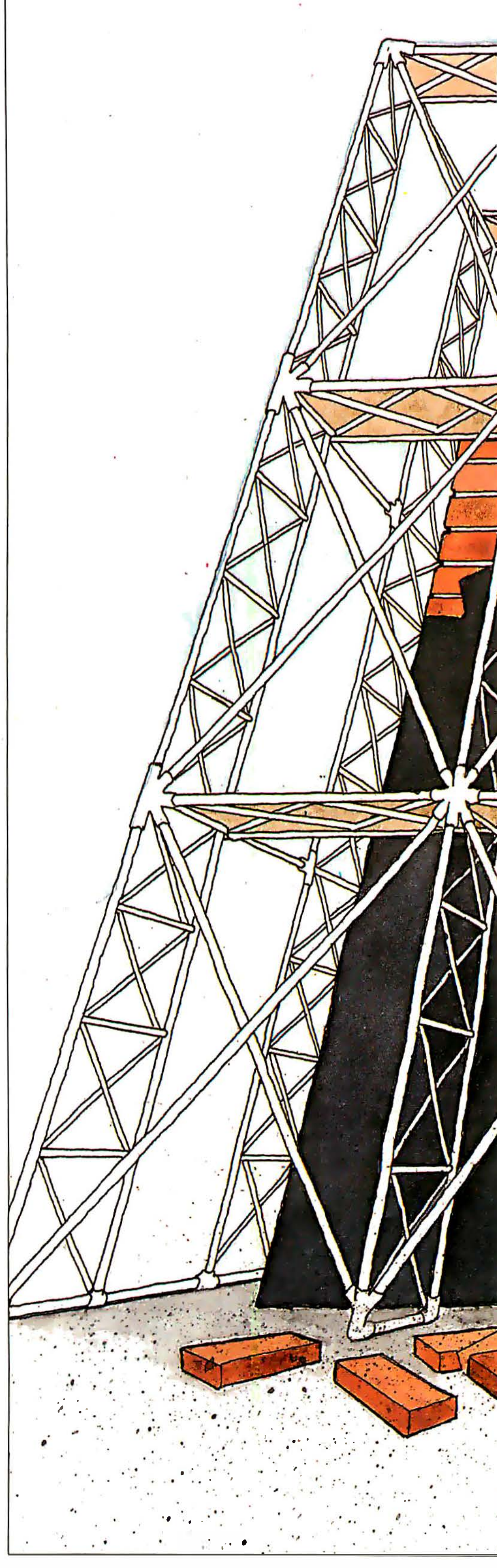
Software "toolkits" save programming time

We are certainly beginning to see some wonderful software—fast, useful programs that give us color graphs, windowed information, and mouse-based cursors. Unfortunately, such software involves a tremendous amount of programming. Since more time at the programmer's computer usually translates to more dollars at the software store's cash register (in a market where software prices are high enough as it is), both you and the software publisher are part of a two-sided dilemma. On the publisher's side, the dilemma has to do with choosing between producing the more complicated software and raising its price, or *not* producing it because he believes he will not be able to sell it profitably. On the user's side, you can either buy the software you see or not—you have little direct influence on what software gets developed. Unless we can all improve our standard of living so that we won't mind spending $1200 for a spreadsheet, it looks like it's up to the software publisher to come up with an answer to this problem.

There is one sure way to keep a product's price from rising—reduce manufacturing costs. You can be sure that software publishers are looking at every phase of their operations for places to cut costs, and since development represents the largest percentage of that cost, why not start there? The quest for lower development costs has given us such things as new programming languages, productivity tools, and program generators. A promising solution being used by several software developers is that

(continued)

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ILLUSTRATED BY RICHARD COWDREY


RCOWDREY

A software framework defines much of an application's operating environment so that the programmer can concentrate on the application itself.

of the *software framework*, a program (often enhanced by a programming language and/or environment) that defines much of an application's standard operating environment so that the programmer can concentrate on implementing the application itself. In this article, we will look at Apple Computer's Toolkit/32 as a representative example of this type of software. Toolkit/32 significantly reduces the time needed to create an application that runs in the Lisa's desktop-metaphor environment.

(You should not confuse my concept of "frameworks" with the Framework integrated-software package from Ashton-Tate, which was announced after I had finished writing this article.)

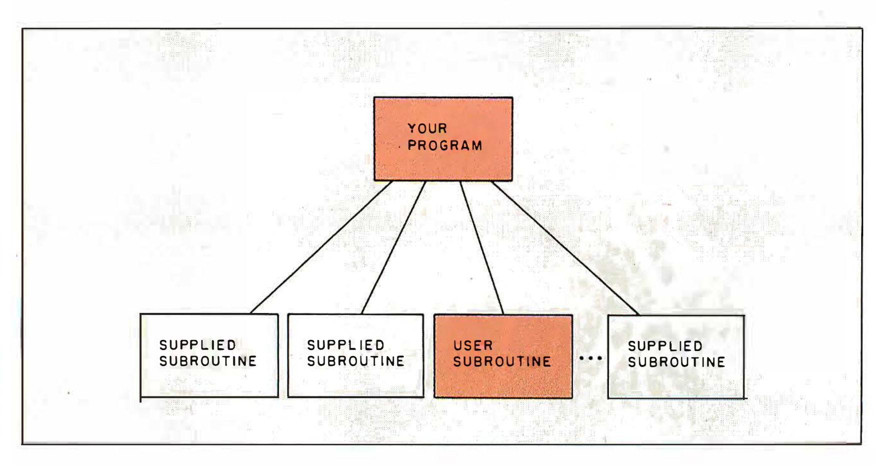


Figure 1: *Creating an application program using a subroutine library. When you must make an application given a library of useful subroutines, you must write the driver program and whatever custom subroutines (shaded) are needed to create the application. If the application is embedded in a sophisticated user interface, you will spend a long time "reinventing the wheel" (writing the code to implement an already-specified user interface).*

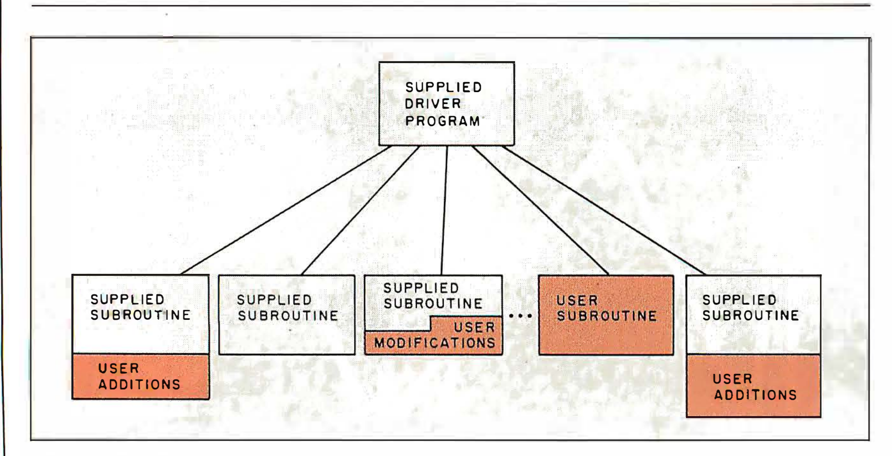


Figure 2: *Creating an application program using a software framework. If you have been given a software framework that implements the user interface but nothing else, you need only write code that implements your application. In some cases, you will write entire subroutines; in others, you will modify ones already in the software framework.*

Conventional Program Design

Software has too often been cobbled together on an entirely custom basis—that is, each program is created without making use of any previously written code. Sometimes, a software designer who has a number of similar programs to write will create a library of useful subroutines that can be copied as needed into programs. In some cases, as with the Macintosh Application Toolbox in which a 64K-byte ROM (read-only memory) of routines is built into Apple's Macintosh computer, these routines can be quite powerful and can eliminate a large amount of needless programming. In such cases, the programmer will write a main program that makes heavy use of their own subroutines as well as those supplied (see figure 1).

What is wrong with this setup? Nothing—it's just that it often isn't enough. Much of the main program is merely program "glue" that coordinates the calling of the supplied subroutines. When a program is sophisticated enough, though, even the coordinating software is complicated. Consider the Lisa applications, all of which use the same user interface. The application program must interact quickly with user input (keyboard, mouse, and mouse button) to create complicated output in the form of graphics, text, and windows. In addition to performing its dedicated function (e.g., drawing graphs, maintaining a spreadsheet), an application must do many things that do not change from application to application: update the video cursor when the mouse is moved; display a pull-down menu when a menu title is selected (cursor on title, mouse button pressed and held); execute a given task when a menu item is selected (cursor on item, mouse button released); move a window when it is being dragged (cursor on window title, mouse button pressed and held); resize a window when its "grow box" is pulled (cursor on box, mouse button pressed and held); receive characters when they come in from the keyboard; redraw hidden parts of a window when it is

In the toolkit approach, the supplied program is in control and coordinates system-general behavior, such as moving windows.

brought from behind several other windows (mouse button clicked when cursor is on some visible part of window); expand a selected icon to a window (cursor on icon, mouse button pressed twice quickly); and numerous other less visible tasks. Given all this, using a set of subroutines to develop such a program is like asking for a ride downtown and being shown to a warehouse of auto parts—you don't want to build the car yourself, you just want to get downtown.

The Toolkit Approach

Bruce Blumberg, J. Peter Young, and Larry Rosenstein of Apple's Apple 32 division have devised an alternative. Imagine a completely functional Lisa application that allows you to pull down menus, create, move, scroll, and rearrange windows, update the video display to correspond to mouse movement, and do all the other things associated with the Lisa user interface—only the windows and menus are blank. Then you (as programmer) need only add or modify code to show what's in a window and, in general, specify the behavior necessary to your application (as opposed to being generic to the Lisa user interface). Apple's Toolkit/32 gives you this capability.

The difference in philosophy is significant. In the traditional approach (figure 1), you are responsible for orchestrating correctly both system-general and application-specific behavior. In the toolkit approach (figure 2), you only have to modify and add subroutines to get your application to work. The supplied program is in control and coordinates system-general behavior (e.g., moving and scrolling windows); it calls your code when it needs to know what application-specific behavior you want (for example, what to show in a certain window).

There is nothing wrong with the toolbox (subroutine library) approach—it is certainly better than having to write everything from scratch. It's just that most software developers don't want the absolute freedom to combine library subroutines arbitrarily—they just want to adapt their program to run correctly within the standard desktop-metaphor environment and do it as quickly (and, therefore, as inexpensively) as possible.

An Example

Let's see how a simple application can be written using an application framework like Toolkit/32. In a few hours, the people at Apple created a simple application called Lisa Boxer. In it, any window opened contains two shaded rectangles that can be moved around. The specific code needed to do this was five pages of Pascal-like code—not much at all, considering the amount of space and comments a structured program includes (see listing 1 for a segment of the code).

(continued on page 394)

Listing 1: *An example of Clascal code. This code, part of a five-page listing that creates the Lisa Boxer application, defines the methods that the class TBoxView responds to (i.e., the messages that objects of that type understand) and the code that executes when this class is created. Methods are capitalized, while fields are not. See the text for more details.*

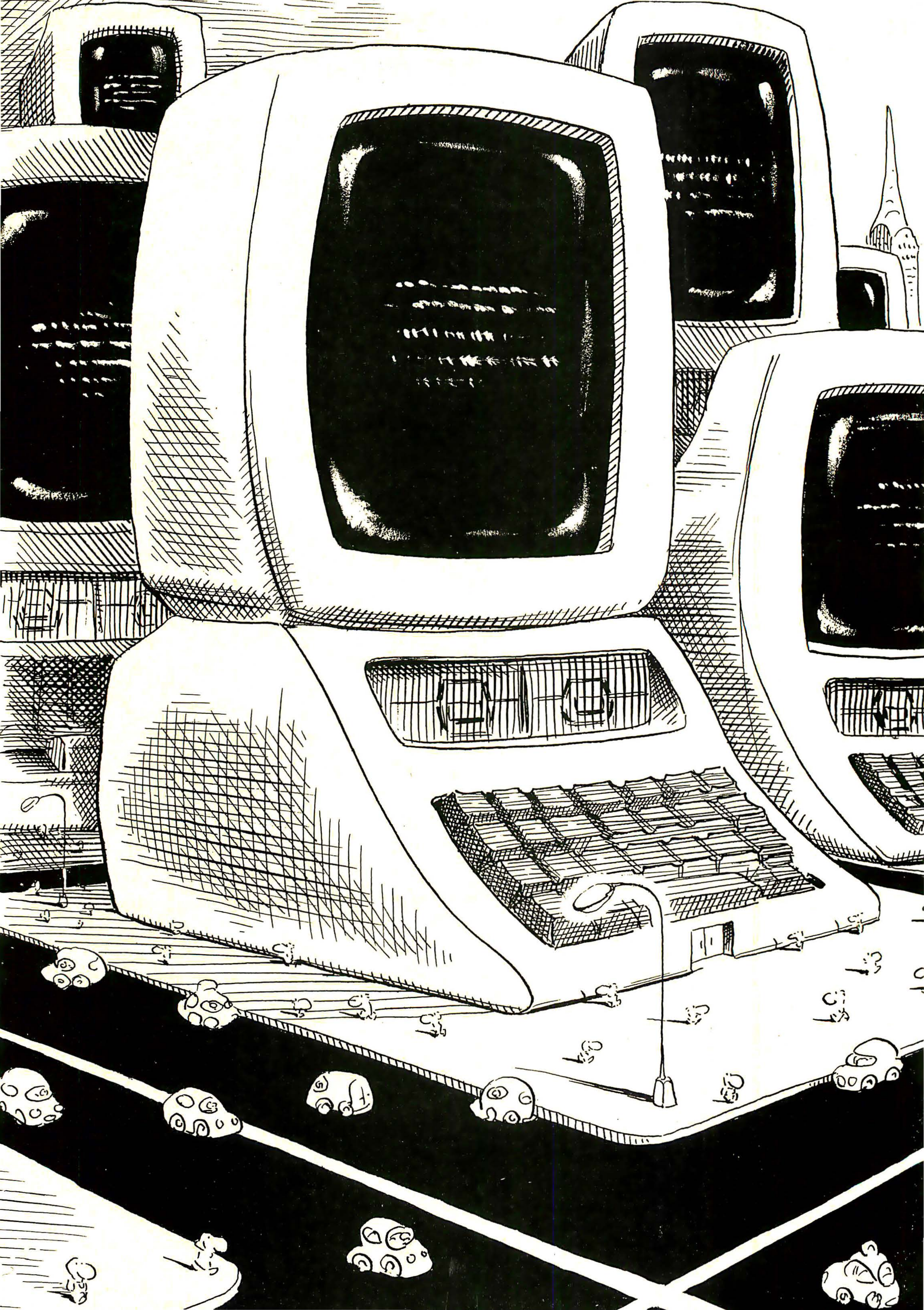
```
METHODS OF TBoxView;
    FUNCTION (TBoxView.)NEW((itsHeap: THeap; itsPanel; itsExtent: LRect;
                itsBoxList: TList; itsPrintable: BOOLEAN): TBoxView);
    BEGIN
        ($IFC fTrace)BP(11);($ENDC)
        SELF := SubObject(TView.NEW(itsHeap, itsPanel, itsExtent, itsPrintable),
                SIZEOF(SELF));
        SELF.boxList := itsBoxList;
        ($IFC fTrace)EP;($ENDC)
    END;

(This returns the box containing a certain point)
    FUNCTION (TBoxView.)BoxWith((LPt: LPoint): TBox);
    VAR box:    TBox;
        s:      TListScanner;
    BEGIN
        ($IFC fTRACE)BP(11);($ENDC)
        boxWith := NIL;
        s := SELF.boxList.Scanner;
        WHILE s.Scan(box) DO
            IF LPtInLrect(LPt, box.shapeLRect) THEN
                boxWith := box;
        ($IFC fTrace)EP;($ENDC)
                END;

(This draws the list of boxes)
    PROCEDURE (TBoxView.)Draw;
    VAR box:    TBox;
        s:      TListScanner;
    BEGIN
        ($IFC fTrace)BP(10);($ENDC)
        s := SELF.boxList.Scanner;
        WHILE s.Scan(box) DO
            box.Draw;
        ($IFC fTrace)EP;($ENDC)
    END;

CREATION
BEGIN


    cBox := NewClass('Apple', 'TBoxView', SIZEOF(TBoxView), 1, 1);
END;
```



Communications

DATA COMMUNICATIONS has generally been considered a distinct subset within computing. It's not an easy topic to become familiar with for a variety of reasons. A major one is expense—not so much for modems and communications software (although neither of these is cheap) as for line and connect charges. You can run up a phone bill of coronary proportions faster than you ever thought possible. As a result, progress in getting the actual benefit from data communications has been left up to corporations and insomniacs. Nevertheless, progress is being made, and several of the articles in this section will attempt to impart tricks of the trade.

Specifically, Suzana Lisanti's article about using on-line databases to their best advantage may give you some ideas for getting into and out of information repositories as quickly and efficiently as possible.

David Barr and George Rogers also present some suggestions on what to do to get the most out of communicating. Their particular concentration is on those criteria that make useful or useless communications software.

One of the best ways to reduce the amount of money you spend on communications is to reduce the amount of time you spend on line. One of the best ways of cutting your connect time is to speed up your transmission rate. Aha! Most of the time you're told, "You can't get there from here," when you try to pass data at rates higher than 1200 or 2400 bits per second. Kim Maxwell's article will tell you why you've been confronted with this particular brick wall and what movement toward a remedy may be in the wind.

Micro-to-mainframe communications may be the key to greater freedom for the individual data-communications application. It's an area that carries with it tremendous potential for working at home, keeping in touch with the office while traveling, and driving yourself crazy when the pieces don't fit together the way they're supposed to. Barry Arnow has written an informative piece that gives you the basics, points out the pitfalls, and guides you to some possible solutions to the problems of connecting your micro to a mainframe.

Finally, there is the field of local-area networking. For all the hoopla that the megabucks associated with LANs have recently generated, it's not all that difficult a discipline to master. As Ed Mier points out, the technology of local-area networking (Ethernet-style) is well established and not particularly mysterious or frightening once you get past the price tag. Scott Haugdahl creates a further sense of familiarity by pointing out the many personal computer local networks at your disposal. You can pick from a broad array of options and, rather than let the variety bewilder, look at it as the high-tech equivalent of a fruit stand during apple season. Once you know the best uses for the different varieties, it's easy to decide whether you want a pippin or a Granny Smith. You get to take your pick from among some known quantities.

All in all, the application of data communications to personal computing is a nontrivial "next step" that can extend your reach (without compromising your control) into new, or certainly broader, areas of information creation, management, and retrieval. Now if we could just do something about the price. . . .

—*Glenn Hartwig, Technical Editor*



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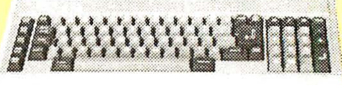
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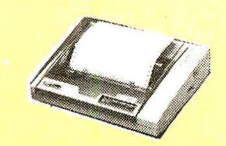


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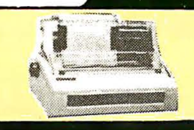
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THE EVOLUTION OF A STANDARD ETHERNET

BY EDWIN E. MIER

Alternatives in wide-band coaxial cable local networks

TO MANY, the world of data communications revolves around the familiar RS-232C interface, relatively low-speed modems, and dial-up telephone lines that have changed little over the past 50 years. But, while these basic elements satisfy most rudimentary transmission needs, a host of newer communications schemes and products offer phenomenally greater capabilities—provided, of course, that you are willing to pay the price.

Today's networking products support data rates a hundred times faster than modem-based phone lines, allow simultaneous interconnection of hundreds of user devices, and offer much better transmission-error rates than dial-up phone lines. These networking schemes (sometimes called local-area networks or LANs), differ significantly from phone-line-based networks in four main areas: geographic scope, network topology, data rates supported, and transmission media.

As the name implies, local networks are constrained in the end-to-end distances they support. [*Editor's note: the author forgoes the IEEE Project 802 committee-generated "local-area network" convention as a confusing redundancy.*] Though the "local" in local network is generally in contrast with the "long-haul" nature of the telephone network, there is still considerable variety among products. Maximum distances between user devices may range from several hundred feet to 30 miles.

Local networks are oriented toward single buildings or campus-like environments, where the space between network stations is freely accessible to the network's operator. Unlike phone-line connections, which may span continents, local networks presume that rights-of-way are not an issue and that cable runs—through conduits, under floors, underground, etc.—to each station location present no legal problems.

TOPOLOGY

One of the most significant differences between local networks and other communications arrangements is in their topology, or logical and physical configuration. Dial-up phone-line circuits connect only two parties, resulting in a point-to-point physical, as well as logical, connection. Local networks, by contrast, connect many stations logically and physically, usually over the same shared transmission medium (see figure 1). Each functioning device on the local network generally may access any other device, or any group of devices, at any time.

The topological uniqueness of local networks—where a common transmission channel is shared by many users at the same time—necessitates high transmission speeds. Compared to phone lines, which support no more than about 9.6K bits per second, local networks usually operate at data rates at or above 1 megabit per second. This is to be expected because many of the terminal nodes need a portion of the overall data-carrying capacity, or bandwidth. By contrast, only two users need to share the bandwidth of a phone-line circuit.

(continued)

Edwin E. Mier is Western Bureau Manager for Data Communications *magazine. He can be contacted at 425 Battery Street, San Francisco, CA 94111.*

Local networks employ a variety of transmission media in addition to the twisted-pair copper wire. The most common is a coaxial cable, usually ¼-inch to ½-inch in diameter, consisting of a central conductor surrounded by a dielectric insulator, all contained within a wire-mesh or extruded-metallic sheathing. A newer medium used in local networks is lightwave, or fiber-optic, cable.

Coaxial-cable transmission uses one of two technologies: broadband, where multiple channels are frequency-divided over a wide radio-frequency (RF) bandwidth of about 400 MHz; or baseband, where a single modulated carrier signal carries the traffic of all the attached stations.

The cable television (CATV) industry has used broadband transmission widely for years, and essentially the same technology, with the addition of RF data modems, has been carried over for use in data networks. Baseband coaxial transmission for local networks was first applied in the early 1970s. Originally an experiment within Xerox's Palo Alto Research Center, it resulted in the Ethernet local-network concept.

Ethernet

The term "Ethernet" has become almost synonymous with local networks. Ethernet was among the first commercial local-network offerings. It is one of the more prevalent designs in use today but it is by no means representative of all local networks.

Still a trademark of Xerox Corporation, Ethernet was first unveiled commercially in the late 1970s as a method for connecting Xerox office products. However, the concept of a single transmission cable, capable of interconnecting a variety of computer-based devices, quickly caught on within the industry.

In 1980, the first Ethernet technical specification, Release 1.0, was made public, coupled with a joint announcement by Xerox, Intel Corporation, and Digital Equipment Corporation (DEC), that all three would adopt the same compatible Ethernet local-network scheme for the attachment of their respective products and systems. This gesture was made, not surprisingly, at the same time that the Institute of Electrical and Electronics Engineers (IEEE) was beginning to define a standard for local-network structure and operation.

Local-Network Standards

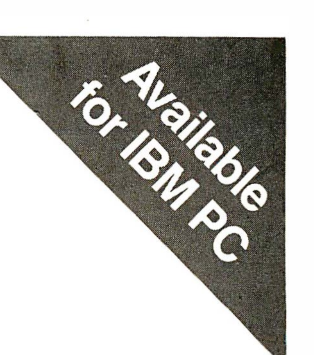
Clearly, no major computer vendor wanted to jump on the Ethernet bandwagon until it became reasonably certain that the overpublicized local-network scheme would in fact be adopted as a standard.

As it turned out, the IEEE local-network standards group, the Project 802 committee, decided to develop several different local-network standards, the first of which was similar to the original Ethernet specification endorsed by Xerox, Intel, and DEC (see the text box "The Ethernet Specification" on page 134 for more information). The IEEE divided its work into three major subgroups, each dedicated to a different type of local-network access method.

The IEEE 802.3 subcommittee worked on the standard that essentially followed Ethernet: a 10-megabit-per-second baseband coaxial cable-based local network that used an access-control method called carrier-sense multiple-access with collision detection (CSMA/CD). This access-control method and several other aspects of Ethernet had some undesirable design limitations (some of

(continued)

Figure 1: *The topology of the local network shows that many stations can be connected—both logically and physically—over the same medium.*



What C did for Programming Mark Williams has done for C Programming

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which I'll discuss later), but the majority of the IEEE participants accepted the fact that Ethernet was the closest thing to a de facto industry standard at the time.

The IEEE also developed two other, considerably different, local-network "standards": one employing a bus topology (akin to Ethernet's, where all devices listen to all transmissions all the time) and another that uses a ring topology. Both employ an access mechanism called token passing. IBM favors the token-ring approach, where each device in the ring retransmits every message it receives in turn. The token-bus subcommittee developed a specification now known as IEEE 802.4, while the token-ring scheme was designated IEEE 802.5. Both of these "Ethernet alternatives" have only recently been approved as standards.

Despite the fact that all three local-network alternatives (802.3, 802.4, and 802.5) were under development

(continued)

The Ethernet Specification

The Ethernet specification, which is now also an IEEE standard (IEEE 802.3), spells out every detail of Ethernet construction and operation (see figure 2). To be "Ethernet-compatible," a local network or board-level interface must conform to every detail relating to cabling, control, physical interfaces, and packet structure. The following is a capsulized summary of the specification.

Ethernet requires a 50-Ω (ohm) coaxial cable, with impedance varying no more than + or − 2Ω. The maximum signal loss from one end of a cable "segment" to the other is 8.5 dB (decibels) at 10 MHz. Cable shielding may allow for an ambient field of no more than 2 V (volts) per meter (for operation up to 30 MHz), and a transfer impedance of no more than 1 mΩ (milliohm) per meter for operation from 0.1 to 20 MHz. The cable itself consists of a 0.0855-inch center conductor of solid tinned copper, a foam polyethylene or foam Teflon core insulator, and a PVC (polyvinyl chloride) or Teflon fluorinated ethylene propylene (FEP) jacket. The outside cable diameter must be 0.405 inch.

Up to 100 transceivers, or taps, may be placed on a cable segment, but they must not be closer together than 2.5 meters. Single cable segments may be 1500 feet in length; extensions are possible if you use "repeaters," which regenerate the signal from one cable segment to another.

Ethernet cable attachment is "passive": that is, the cable is not broken or cut, and the tap (a "vampire" type with two piercing "fangs") can normally be inserted or extracted without affecting other communications over the cable. The transmit power level is −1.025 V DC (direct current) (at 41 mA (milliamperes); variations are from −0.9 to −1.2 V (36 to 48 mA). Voltage must never be positive on the coaxial cable.

The transceiver encodes data on the cable using Manchester encoding to ensure a signal transition in the middle of each bit "cell," or data transition. Each bit cell is 100 ns (nanoseconds) long (+ or − 0.01 percent). The data rate is 10 megabits per second. The transceiver cable, up to 50 meters in length, consists of four pairs of #20 or #22 gauge wire inside an insulating shield jacket. Impedance is 78 Ω and maximum signal loss is 3 dB at 10 MHz. One male and one female 15-pin D-series connector terminates either end of the transceiver cable. Naturally, pin assignments are all specified in the standard.

The minimum size of a packet is 72 bytes; the maximum packet size is 1526 bytes (see figure 2). No device may transmit if a carrier is detected on the cable, and a minimum waiting period of 9.6 μs (microseconds) must be observed after one transmission before another can begin. In the event of a collision, devices must back off for a random period of time before retransmitting. The period is determined by a "back-off" algorithm designed to accommodate up to 1024 stations on the cable.

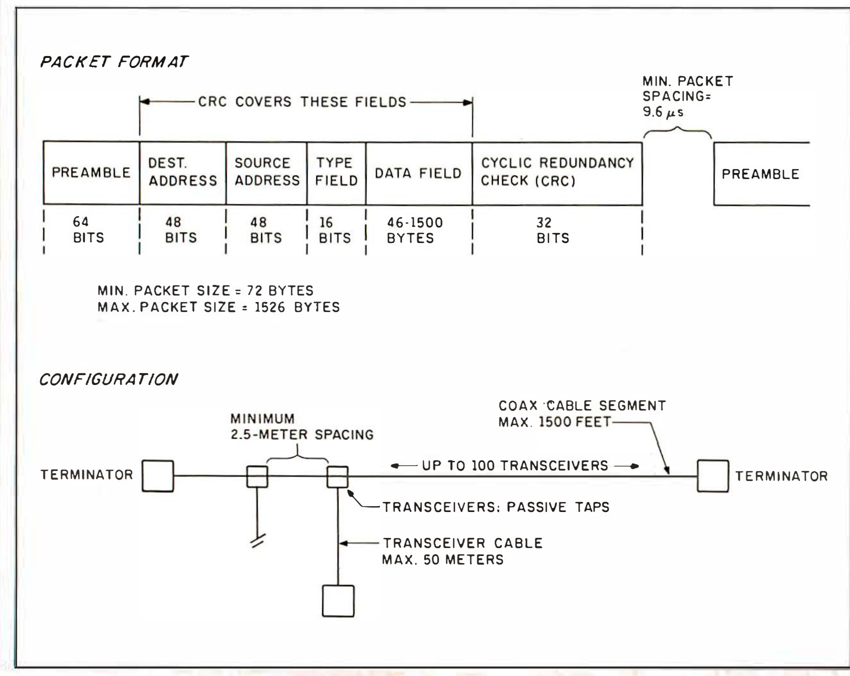


Figure 2: *The Ethernet specification, as defined by Xerox and later the Project 802 committee of the IEEE, covers physical and logical dimensions.*

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at the same time, Ethernet implementations began to mushroom when the IEEE's CSMA/CD specification (802.3) finally began to solidify. In fact, the DEC-Intel-Xerox triumvirate, which pioneered the initial Ethernet "standard," made several subtle changes to their specification to bring it in closer alignment with the IEEE 802.3 document.

As a result, IEEE's 802.3 and Ethernet are today virtually identical. Technical gurus familiar with both specifications maintain that a later-release Ethernet implementation will handle all the functions required by the IEEE 802.3, and that the remaining differences will be inconsequential.

Ethernet Pros and Cons

The Ethernet specification, and the IEEE 802.3 document that embodies it, allows devices with compatible interfaces to be interconnected over a shared coaxial cable. However, without higher-level software, devices from different manufacturers are still not able to communicate. This is because the true differences between computers are not addressed by the Ethernet standard, only their ability to exchange bits on a physical level.

It is at these higher levels that many who buy Ethernets or Ethernet-compatible products are sorely disappointed. Table 1 shows a comparison of the characteristics of the leading Ethernet-compatible board manufacturers. It should be noted that, even though the microprocessor chip sets employed are different, all will interact reasonably well together over the common Ethernet cable. However, note that there are two different higher-level protocol sets employed by the different manufacturers: XNS and TCP/IP.

The Xerox Network System (XNS) is perhaps the most prevalent of the high-level protocols employed in Ethernet interfaces today. It is a derivative of the software developed by Xerox for handling network messaging and logical session management between devices over the Xerox Ethernet.

The Transmission Control Procedure/Internet Protocol (TCP/IP) is a set of network software utilities that perform the same functions as XNS. TCP/IP is borrowed from the software developed by the Department of Defense for use in handling network connections over the early Advanced Research Projects Agency Network (ARPANET), a long-haul packet-switching network constructed in the 1960s.

In their zeal to market early Ethernet-compatible products, manufacturers chose one or the other of these high-level protocol sets. As a result, an interface from a vendor using one of these protocol sets generally will not work with an interface board that employs the other. Ironically, this subtle difference in software, quite often fixed in the Ethernet interface's ROM (read-only memory) firmware, negates the universal interconnectivity that was the whole point of the Ethernet local network.

Table 1: *A significant point is that vendors supporting the XNS protocol and those supporting the TCP/IP protocol produce noncompatible gear.*

Ethernet Plug-In Board Vendor	On-Board Micros	High-Level Protocol Set	Host Environment	Cost
Bridge Communications Cupertino, CA Ethernet Controller/2	M68000, AMD Lance	XNS	UNIX (OEM to Honeywell)	$1500–$3000
Communication Machinery Corp. Santa Barbara, CA ENP Series	M68000, AMD Lance	XNS, or TCP/IP	UNIX, RSX, VMS	$2000–$3000
Excelan San Jose, CA EXOS 200 Series	Intel 80186, 82586	TCP/IP	UNIX (OEM to NCR)	$2000–$4000
Interlan Westford, MA NET/PLUS Series	Current AMD 2901 Bit-Slice Intel 80186, 82586 planned	XNS	UNIX, RSX, VMS, DG AOS, RDOS	$1400–$3200
3Com Mountain View, CA EtherSeries	None, uses host processor	XNS	IBM PC, TI Professional, HP 150	$800

Cost Sharing

Early Ethernet interfaces cost between about $2000 and $3000. Each consisted of two, and sometimes three, plug-in boards. Users with several microcomputers to network generally scoffed at the idea of using Ethernet because of the cost. The few early Ethernet installations typically connected high-performance minicomputers from the same vendor, such as DEC VAXes, where high-speed communications within a processor "cluster" were needed and board space and cost were not as critical.

The first big break for Ethernet came when vendors realized that a single interface could be shared by many devices, thereby significantly lowering the Ethernet cost-per-device-attachment. These multiport stand-alone interface units generally offer RS-232C ports for attaching terminals and microcomputers in the dumb, asynchronous-terminal mode. A few examples of these terminal servers currently include:

- Interlan's NTS-10 Network Terminal Server, either in 4- or 8-port versions, incorporates Intel 80186 and 82586 (Ethernet) microprocessors with 128K bytes of RAM (random-access read/

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write memory). Cost for an 8-port server is $3200, or $400 per attached device.

•Bridge Communications' CS/1 Communications Server is available in 8-, 16-, 24-, or 32-port versions. The CS/1 reportedly will support asynchronous and bisynchronous terminal devices via RS-232C, RS-449, and CCITT (Consultative Committee for International Telephony and Telegraphy). Price for a 32-port version starts at $9900, or roughly $315 per attached device. The CS/1 is said to be driven by a Motorola 68000 processor with up to 512K bytes of RAM.

•Ungermann-Bass's NIO-150 Network Interface Unit supports up to six RS-232C-equipped ports. A six-port unit costs $2800, or roughly $450 per device.

There are other manufacturers of shared Ethernet interfaces, and prices are expected to drop even lower as specialized Ethernet chip sets become widely available and implemented. Via these multiport adapters, you can reasonably expect attachment prices per device to eventually nestle into the $250 to $300 range. Ethernet terminal connections then would be reasonably competitive with other local-area transmission means, such as short-haul or limited-distance modems and twisted-pair phone lines.

Chip Sets

The greatest boon to Ethernet and Ethernet-like local networks is the reduction of the complex control circuitry to several semiconductor chips. A number of chip suppliers have decided to vigorously pursue this market, the two most notable being Advanced Micro Devices, or AMD, and Intel.

The AMD Ethernet microprocessor, called Lance, will reportedly handle most Ethernet packet-forming and network-control functions and will interface with a number of 16-bit microprocessors, including the 8086, Z8000, Motorola 68000, and DEC LSI-11. The Lance is generally employed in the same board with one of these processors, along with another chip called the serial interface adapter (SIA).

The SIA, increasingly based on bipolar technology and available from chip makers such as Seeq and Fujitsu, performs many of the Ethernet synchronization and Manchester encoding (a straightforward modulation technique in which an electrical pulse represents either the clock signal or logical 1 and the absence of a pulse equals logical 0) functions associated with the cable transceiver. Ethernet board suppliers adopting or planning to adopt the Lance microcomputer reportedly include Communications Machinery Corporation (CMC), Bridge Communications, and DEC.

Intel's Ethernet chip offering is the 82586, which is said to be a more generic microprocessor than the AMD Lance, although still oriented toward Ethernet network processing. When large quantities of this chip are available, deployment with one of Intel's generic microcomputers, probably the 80186 or 80286, will comprise the Intel-based single-board Ethernet interface. The 82586 reportedly costs more than AMD's microprocessor, although the current $80 price tag for quantity purchases is expected to drop. Ethernet interface suppliers said to be awaiting delivery of the Intel chips include Hewlett-Packard, Excelan, and Interlan.

Ethernet Support

End users typically have two choices for implementing an Ethernet: they can either buy plug-in boards for their processors, which requires some host-software modification, or they can buy Ethernet interfaces from the computer manufacturer, which generally come complete with software for

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specific processors and network applications.

For the most part, computer manufacturers are licensing Ethernet interfaces from one of the plug-in board suppliers. Honeywell, for example, added its own software interfaces to Ethernet hardware acquired from Bridge Communications. Honeywell now offers Ethernet adapters for its DPS 8 and 88 mainframes, DPS 6 minicomputer, and 6/10 and 6/20 microcomputers.

Other computer vendors that have jumped on the Ethernet bandwagon include DEC, Hewlett-Packard, Data General, AT&T (for its 3B UNIX-based systems), Texas Instruments (for its complete line of System 300, 600, 800, and 900 series processors) and NCR (for its Tower multiuser system). NCR now offers a personal computer local network believed to be licensed from Corvus, which sells a popular low-cost Ethernet-like local network for a variety of vendors' microcomputers.

Corvus claims that almost 60 percent of all personal computers now connected to local networks use the Corvus Omninet. Omninet operates at 1 megabit per second, employs the same standard twisted-pair wiring used for telephone communications, and features software support for many of the most popular microcomputers, including IBM's PC and PC XT, DEC's personal computers, TI's Professional, Apple IIs, and Zenith's. In addition, Corvus sells one or more of its print and file servers with each of its Omninets.

Logically speaking, Corvus's Omninet is similar to Ethernet in design, but it is not compatible with Ethernet because it uses twisted-pair wire for data transfer instead of a coaxial cable. The Omninet's 1-megabit-per-second data-transfer rate saves considerably on the cost of transceiver circuitry. Omninet employs a bus-type structure like Ethernet, and a CSMA access method. However, rather than the collision detection employed in Ethernet, Corvus employs a simplified scheme called collision avoidance, which reduces costs by shrinking the amount of logic and processing required to handle this function.

Corvus is a local-network vendor that has deviated from the Ethernet standard and improved on many of the Ethernet design limitations that have kept costs high. The company has had unquestionable success. Corvus boasts of a per-microcomputer connection cost of under $500. In comparison, Ethernet-compatible interfaces, including the necessary computer-specific software, typically still cost at least $1000.

Corvus is believed to have designed its own semiconductor chip set, which is reportedly being produced by an unnamed Japanese manufacturer. This chip set is expected to further reduce the cost of the company's local-network interfaces. Corvus is also expected to use the new chips in a higher-speed Omninet version, operating at 4 megabits per second, with first deliveries expected sometime in 1985.

Ethernet Competition

Ethernet has unquestionably made great strides, given its adoption as an IEEE standard and the appearance of affordable Ethernet-compatible controller chip sets, but the long-term viability of the local-network scheme is still the subject of controversy. Two things could determine whether Ethernet has a prosperous future or is relegated to obsolescence. One is the impact of IBM's local network; the other is the possibility that significant changes to the existing Ethernet standard, now under consideration by the IEEE, may be adopted.

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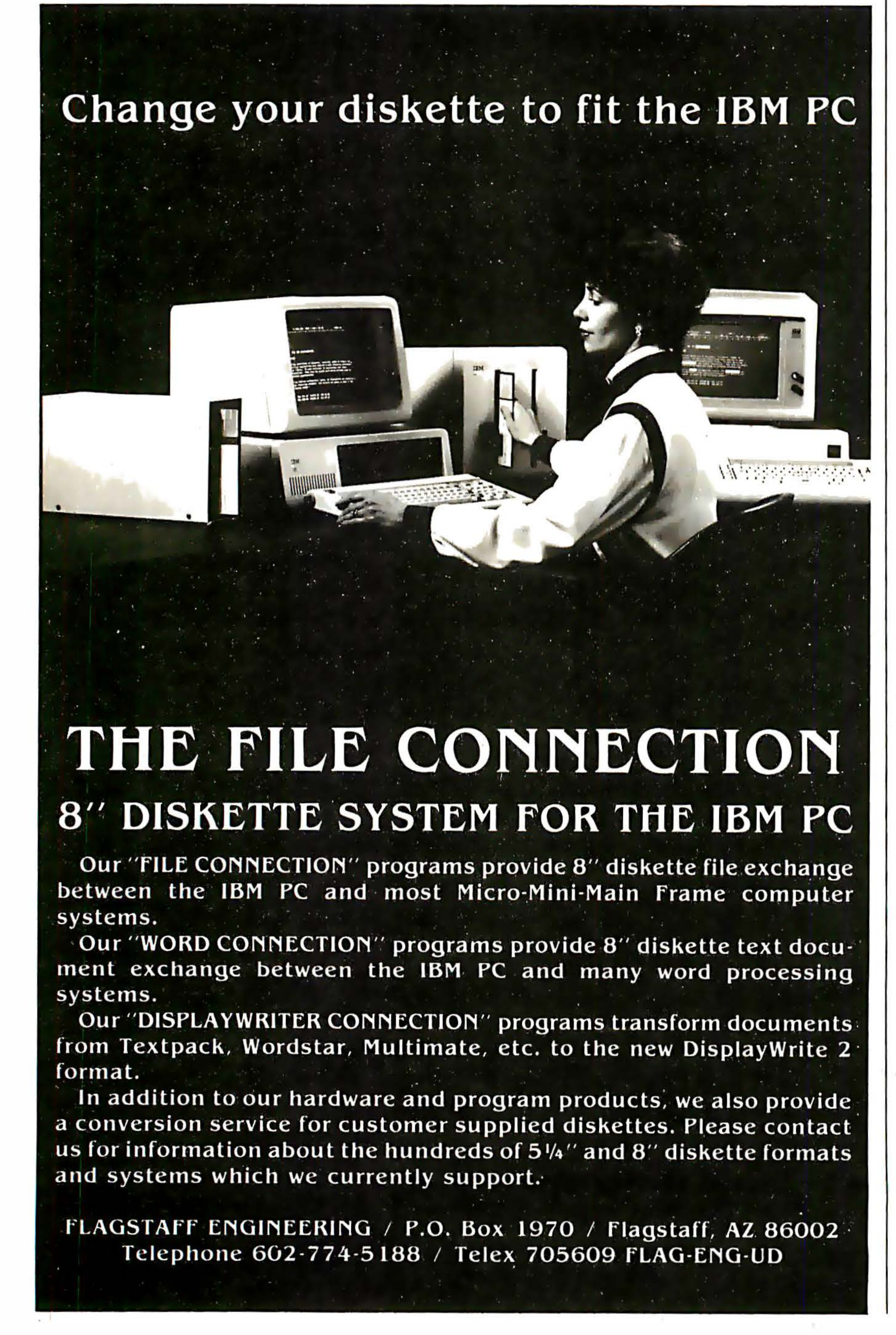
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Network, a broadband-based local network that is not affiliated with the cabling system it had unveiled a few months earlier (see "The IBM PC AT," October BYTE, page 108, for more information). IBM's still-unannounced local network for its cabling system will employ the same token-passing specification that the company helped define within IEEE 802.5.

The IBM token ring and Ethernet are widely divergent schemes, though both employ a compatible link-level control (LLC) protocol that the IEEE has insisted be common to all of its local-network specifications. This means that a "gateway" type of processor can reasonably be expected now that IBM has entered the local-network market.



Gateways, however, tend to be bottlenecks, especially when they connect two or more high-speed local networks. So, while rudimentary interconnection between IBM token rings and Ethernets can be expected to accommodate already-installed Ethernets, IBM's dominance in mainframes and microcomputers could signal a slow death for Ethernet and Ethernet-compatible products.

There is also a possibility, some say a probability, that the IEEE may significantly alter, or add to, the existing Ethernet standard, which could make current products obsolete. Ethernet vendors are expected to resist any drastic changes by the Project 802 committee, but changes that address some of Ethernet's limitations are nevertheless expected. These are embodied in two proposals now circulating within the IEEE: one is called Star-LAN and the other is a modification to the Ethernet cabling called Cheapernet.

Star-LAN calls for a twisted-pair adjunct to Ethernet through which user devices would be connected in a "star" topology from a small centralized bus-based local network with a gateway to a conventional Ethernet. Devices would transmit and receive at 1 megabit per second over the simple twisted-pair extension to a still-unspecified Ethernet interface. The current Ethernet standard allows a device to be no more than 50 meters from the main cable, attached via an expensive transceiver-to-device cable.

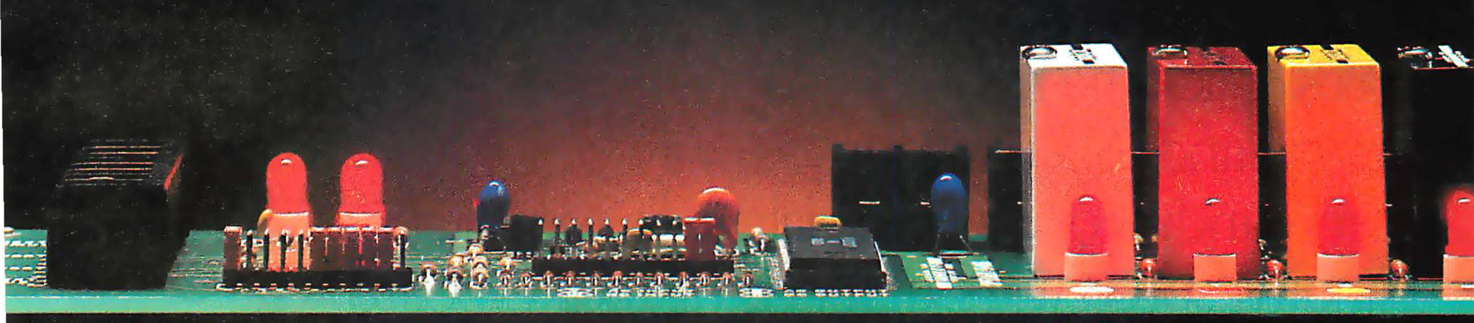
The Cheapernet proposal calls for a thinner, cheaper coaxial cable than is now used in Ethernets. Because this type of cable wouldn't offer the same electrical characteristics as the cabling in the Ethernet specification, it could only be used over shorter distances and with fewer devices. Still, many IEEE members are said to favor the proposal which, if approved, could result in lower-cost components. These components, in turn, would probably not support the specifications delineated in the original Ethernet. ■

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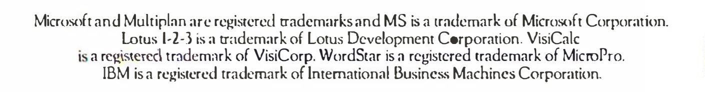
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LOCAL-AREA NETWORKS FOR THE IBM PC

BY J. SCOTT HAUGDAHL

Be sure of your networking goals and needs before you invest in expensive technology

THERE ARE 40 OEMs (original equipment manufacturers) of personal computer local networks in the industry; 18 (not including third-party OEMs) of these are basically only for the IBM PC. *None* of these systems is fully compatible with any of the others. Most were introduced in 1983, and many are from "me-too" vendors that have jumped on the IBM PC local-area-network (LAN) bandwagon. Table 1 indicates the wide variety of local networks available for the IBM PC.

Every vendor usually claims that it has the best technology, the best idea, the best implementation; clearly, this cannot be true for all of them. Manufacturers would like you to believe in the idea of the turnkey system, the kind of information source or utility that you simply plug your computer into and it works beautifully. No system is really as turnkey as we'd like it to be, mainly because the technology is so new. The oldest personal computer LAN vendors are three to four years old.

As everyone should be aware of by now, a revolution has taken place over the past 10 years in silicon and integrated circuit technology. The result is that the cost of a central processing unit is really a small fraction of the cost of a whole system. The real cost is in the electromechanical peripheral devices connected to a system—disk drives, printers, etc., and the necessary support circuitry it takes to drive them. Thus, with LANs you want to preserve the benefits of stand-alone microcomputers, namely, use of your favorite software and peripherals and having a machine all to yourself, as well as adding new benefits from networking. Besides sharing expensive peripherals, you can add electronic mail, multiuser databases, high-speed communications between personal computers, minicomputers, and mainframes, and a slew of multiuser applications such as accounting and inventory control.

J. Scott Haugdahl is a systems specialist at Architecture Technology Corp. (POB 24344, Minneapolis, MN 55424), *a consulting firm that specializes in computer architecture, including local-area networking systems. He is coauthor of the company's "Personal Computer Local Network" seminar series.*

An interesting technological issue often ignored by manufacturers is the concept of open versus closed systems. Open systems are basically systems that are built to a published specification—either standardized or designed in a nonproprietary way. With open systems, all the design details of the implementation are published; closed systems are completely proprietary. Most systems that follow de facto standards, such as Ethernet or Arcnet, and those that follow "committee" standards, such as IEEE-802 or those of the National Bureau of Standards, tend to be open systems. Open systems that follow standards also typically allow the user to buy equipment that will work on a specific network from more than one vendor. Most of the microcomputer local networks, however, tend to be highly proprietary, leaving the end user at the mercy of the vendor.

Unfortunately, there are still some technical drawbacks to microcomputer LANs. The worst problem is the need LANs create for very complex and specialized software to handle

(continued)

the communication that will take place over the network. Also, when you are working with a complete system that is going to be spread out over thousands of feet, something may fail and it may be difficult to find out exactly what has failed and where. In the past, with the stand-alone personal computer, if you couldn't read a disk drive you had a pretty good idea that something was wrong with either the disk drive or the disk.

Unique expertise is usually needed in day-to-day operations to maintain and administer these systems. Also, the manufacturer should provide diagnostic tools to help you maintain the network. These are typically software programs that do a variety of tests, such as testing the network or the network interface in a particular computer. You should also be able to diagnose and repair problems concurrent with the normal operation of the network. For instance, if you have a computer that fails, you should be able to take the computer off the network and fix it and then put it back on without having to interrupt the normal use of the network.

The cost of the transmitting cable is probably one of the most deceiving things about LANs. Many vendors tout "low cost" when describing this item, whether it be coaxial cable or twisted-pair wire. The real cost is not the cable itself but how much it costs per foot to install it in a system. A number of companies have actually paid as much as $1000 per foot for installation.

(continued)

Table 1: *A survey of local-area networks that support the* IBM PC *and their features.*

VENDOR	NETWORK	MEDIUM	DATA RATE	ADDRESSABLE NODES *	LINK PROTOCOL	DISTANCE**	SERVER TYPES SUPPORTED	OS SUPPORT	OTHER PCs***
AST Research	PCnet II	T	800K	64K	CS	10	D,P	M	
Christain Rovsing	X-Net	T	1.8M	64K+	P	22	32	M	
Corvus	Omninet	T	1M	64	CS	10	D	M,P,C	Y
Davong	Multilink	C	2.5M	255	A	22	DP	M,P,C	
Fox Research	10-Net	T	1M	255	CS		F,P,32	M	
Great Lakes Computer	Great Net	C	5M	64	P			M	
Gateway Communications	G-Net	C	1.43M	256	CS	10	F,P,32,G	M	
IBM	Cluster	C	375K	64	CS	10	D	M	
IBM	PC Network	C	2M	64	CS	2	F,P,32,G	M	
3M	LAN/I	C	2.5M	255	A	22+	G	M	
Nestar	PLAN 4000	C	2.5M	64K+	A	22	D,P,32,G	M,P	Y
NCR	DecisionNet	T	1M	64	CS	10	F	M,C	Y
Novell	NetWare/X	C	1.43M	256	CS	10	F,P	M	
Novell	NetWare/S	T	500K	24	P	2	F,P	M,C	Y
Orchid	PCnet	C	880K	64K	CS	10	D,P	M	
Percom Data	PerComNet	C	1M	256	TP	10	D	M,C	
Proteon	proNET	T,C,F	10M	256	TP	10	F,P	M	
Standard Data	STANDARDNET	C	3M	256	CS	2	D,F,P	M	
Tecmar	Elan	C	10M	64K+	E	10	D	M	
3Com Corporation	Ethernet	C,F	10M	64K+	E	10	D,P	M	
Ungermann-Bass	Net/One PC Baseband	C,F	10M	64K+	E	10	D,P,32,G	M	
Ungermann-Bass	Net/One PC Broadband	T	5M	64K+	CS	22+	D,P,32,G	M	
VLSI Networks Inc.	1553-Net	C	3M	256	CS	2	D	M	Y
XCOMP	XNET	T	2.5M	256	CS	10	F,P	M	

* Theoretical maximum number (see text of article)
** Repeaters may be necessary to achieve the distance indicated
*** Other than the IBM PC

LEGEND

MEDIUM
T = twisted-pair
C = coax
F = fiber

DATA RATE
K = kilobits per second
M = megabits per second

LINK PROTOCOL
A = Arcnet
E = Ethernet
CS = CSMA
TP = token passing
P = proprietary

DISTANCE
2 = less than 2000 feet
10 = less than 10,000 feet
22 = less than 22,000 feet
22+ = 22,000 feet or more

SERVERS
D = disk
F = file
P = print
32 = 3270
G = gateway

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You probably won't see the transmitting cable cost in an IBM PC LAN cost estimate because these systems tend to be broadband types installed in metropolitan high rises with previously installed cable. On the other hand, cable cost can still be a cost factor in these IBM PC networks, especially if there are a lot of nodes on the system. They call for a lot of wire, and the environment may require union people or an electrical staff to install the system. All of these cost factors are important.

The way a vendor has designed the network interface board that connects the IBM PC to the network varies dramatically from vendor to vendor. Unfortunately, most end users don't really take a look at the hardware; they care more about the functionality at the application level.

This is unfortunate because the performance of these systems has to do with how intelligent the network interface board is. Does it use very-large-scale integration (VLSI) data-link controllers and/or dedicated central processors? Or does it use a lot of basic building blocks, such as small-scale integration (SSI)? Does it support direct memory access (DMA)? How about interrupts? Does it require a lot of processor time, for example, from the IBM PC's 8088 processor to service the card? Or can the IBM PC go off and do its own thing and be interrupted, for example, if a packet has been received? In some systems you can send a packet of data to the network-controller board and go away to perform another task. The controller will form the packet (add headers, addressing, checksums, etc.), sense when the network is free (or wait for a free token), and send the packet to the receiving node, all without any intervention from the IBM PC. On the other hand, some systems require constant attention from the host central processor, adding a tremendous amount of overhead to the system to support the network. In addition, intelligent controllers require less software to support the network—software that has to be designed, debugged, maintained, etc.—

which leaves more memory in the IBM PC for the individual user.

Most LAN data-link protocols in use today were derived from one of two general schemes known as carrier-sense multiple-access (CSMA) and token passing. The Xerox-developed Ethernet uses the best-known implementation of a carrier-sense multiple-access protocol; Ethernet assumes that its nodes will be connected in a bus-type layout and adds collision detection (so the protocol is called CSMA/CD). On the other hand, Datapoint Corporation used token passing over a bus layout in designing its popular Arcnet protocol. Several semiconductor houses are offering or will soon offer special chips for handling these and other protocols, but some local networks, such as Omninet from Corvus and Netware/X from Novell, rely on a dedicated microprocessor.

SERVERS

Let's take a look at servers, since they are key to supporting LANs. A server could be an IBM PC or a specialized "black box" that performs some function at the request of a client.

In general, how can you compare two or more servers? There are a few questions you might ask. What is the capacity of the server? In the case of a file server, how many megabytes of storage can it support? In the case of a print server, how many printers can it support? Can it print concurrently on more than one printer? Does it use virtual printing, spooled printing, or a combination of both? Can you have more than one of a certain type of server on the network?

Because all these servers support multiple users, you're going to need some sort of password protection scheme, as well as some means of protecting the data of one user from another. Also, because large amounts of disk storage are typically handled by a file server, it should support some form of backup, such as a streaming-tape drive. Some servers support other functions, such as a network-wide real-time clock/calendar, and synchronization of processes on

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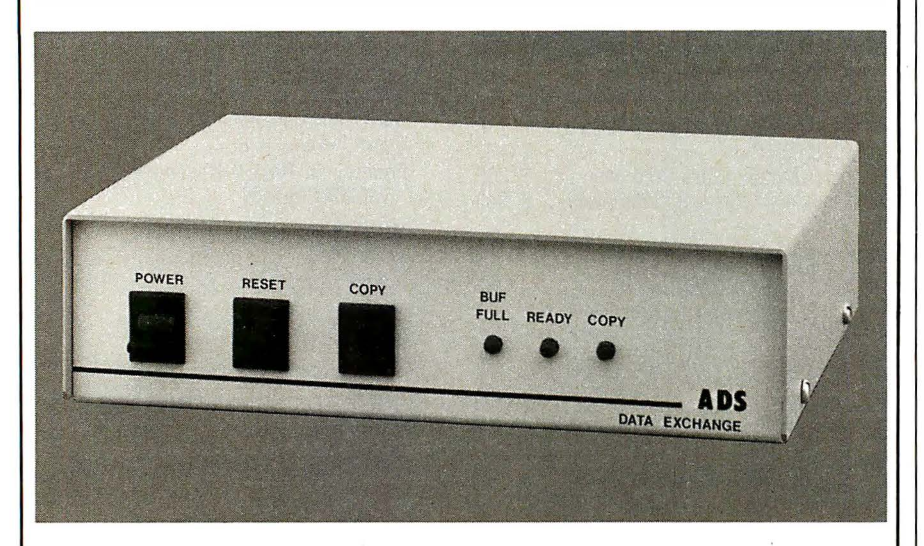


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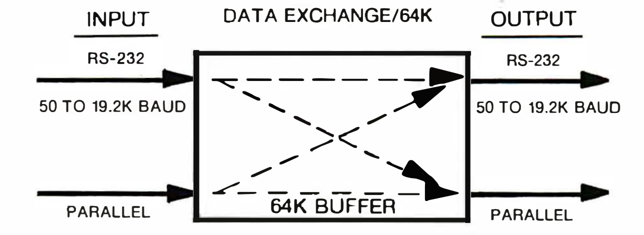
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The disadvantage of dedicated file servers is cost, because they can no longer be used as workstations.

the network by semaphores (flags that are typically implemented by subroutine calls to the network operating system) or lock tables.

Let's look at dedicated versus nondedicated file servers. Clearly, with a dedicated machine, you might hope to provide high performance through dedication. The server doesn't have to worry about anything except servicing requests and is probably more secure than the nondedicated machine; if nothing else, you can lock it up in a back room somewhere and make it physically secure. It is also more secure in the sense that a user program cannot interfere with the server and crash it (as can happen with a nondedicated server).

The disadvantage of dedicated file servers is cost, because they can no longer be used as workstations. However, costs can more than be recovered because response times will be better, thus saving people's time.

I am beginning to see more and more nondedicated servers, particularly in some of the "low-cost" networks that bill themselves as being "easy to afford and easy to install." Basically, this means that the user and server processor can coexist in a single machine, so users, for example, can have PC XTs and share their hard disks with other users on the network at the same time they are running a spreadsheet program. These nondedicated servers clearly have the cost advantage because you don't have to buy a dedicated machine.

They have some disadvantages, too. Nondedicated servers require a multiprocess operating system, which will generally degrade performance. An example of this degradation can be seen on the IBM PC. Every time you

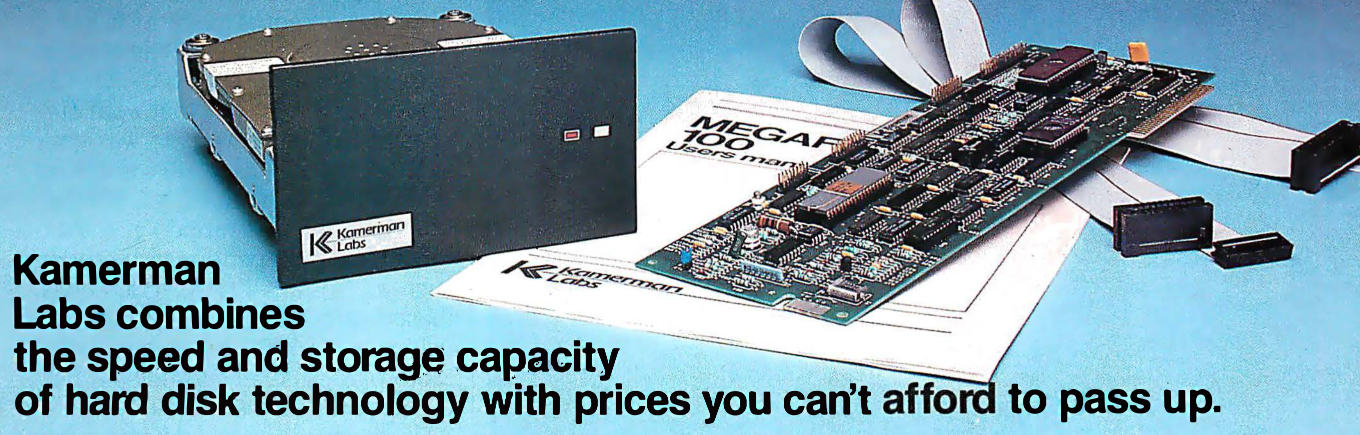
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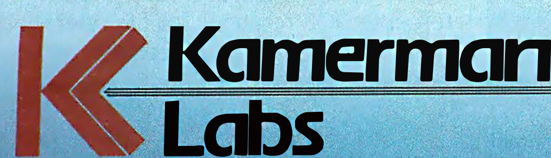
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press a key on the keyboard, you generate a high-priority interrupt. If your nondedicated server machine is used by a typist, you may see the performance of the file server that happens to coexist in the same machine degrade to intolerable levels. Likewise, if suddenly 10 stations on the network try to share your disk, it may take a very long time to recalculate your spreadsheet program.

There is also the issue of security: a programmer may be able to make direct calls to the BIOS (basic input/output system) and circumvent the server's security mechanism, gaining access to files and passwords.

Another trade-off is centralized versus decentralized file service. A centralized file service means there is one file server on the network, controlling the resources and simplifying management, so that you don't have the problem of multiple file copies existing in widely distributed places (as with decentralized file services). You may be able to take advantage of the economies of scale here; instead of buying 10 IBM PCs with 10 small hard disks, you might be able to buy one centralized file server with a large hard disk that can be shared.

However, the server is a potential bottleneck, particularly if you don't go with a high-performance processor. A lot of users on the network can try to access the file server simultaneously. Clearly, if that server should ever fail, all the disks that are on the network are going to be down. The server then becomes a central point of failure.

Most of these centralized networks use off-the-shelf IBM PC XTs as servers. Often, PC XTs that were purchased before networking was considered can be used. If something goes wrong with the PC XT, another one can often be swapped in. On the other hand, high-performance servers, such as Nestar's PLAN 4000 server (based on multibus architecture and using a 68000 processor from Motorola), can offer substantially better network disk-sharing performance.

Finally, there is a real difference between file and disk servers. The terms are often used interchangeably, but most vendors' "file" servers are really disk servers.

Disk servers service users' requests for disk I/O (input/ouput) at a low level. This requires a low-level modification of the users' workstations to intercept BIOS requests for reading and writing disk sectors. Thus the server is really a disk "volume" server, and file I/O is handled directly by the operating system in the PC.

File servers service users' requests for disk I/O at a higher level. This high-level modification to users' workstations is performed at a level that intercepts DOS requests for file operations, such as opening, reading, and

(continued)

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closing. The server then has control over files and can enforce automatic file locking to prevent a file from being written to by two or more users simultaneously. Another advantage of file servers is that disk space for individual users does not have to be preallocated. A user's storage space can grow dynamically as space is needed.

IBM PC Local Networks

Note that while the systems in table 1 are designed for the IBM PC, some may work as well with compatibles. Since more than 30 microcomputers are reasonably compatible with the IBM PC, there are more than 500 combinations of PC-compatibles and LAN systems. It is often up to the user to find out what works together and what doesn't. You should also note that all of the vendors listed plan to support the PC AT as well.

3Com EtherSeries

3Com, a privately held company that went public this spring, has a number of Ethernet products, one of which is the EtherSeries line for the IBM PC. 3Com got its start designing and selling Ethernet components, transceivers, cables, and some board-level products. In December 1982 it introduced the first Ethernet board for the IBM PC, based on the VLSI data-link controller from Seeq Technology. At that time, the board was really just a hardware product with some crude software, but now with the EtherSeries, 3Com has a systems-level product. To no one's surprise, the EtherSeries product is beginning to dominate 3Com's sales and now accounts for about 50 percent of the company's revenue.

EtherSeries is a complete Ethernet system for the IBM PC. The file server (actually a disk server) can be either a PC XT, an IBM PC made to look like a PC XT, or a 3Com machine. IBM PCs require the 3Com EtherShare software package and one EtherLink interface card. Alternatively, you can buy the higher-performance 3Com server that is based on the Altos 586 workstation, which uses a high-speed 8086 processor. The IBM PC version does not require dedication. Both versions can download the disk operating system (DOS) to diskless IBM PCs (which contain an optional boot ROM [read-only memory] on the network interface card).

EtherShare manages virtual disks at the volume level. Passwords are required to "log on," and optional passwords can be placed on volumes. Volumes can be made private for individual use only, public for use by several users in a read-only fashion, and shared for multiple read/write access. However, there is nothing implied in EtherShare that protects multiple writers from corrupting each other's data by writing to the same disk area at the same time. The application software must take advantage of semaphores and locks that are provided by EtherShare.

EtherShare can provide other server functions such as spooled virtual printing (EtherPrint) and electronic mail (EtherMail). An interesting feature of the print server is that you can have multiple users spooling data simultaneously without interfering with each other. The server maintains buffer spool files on the disk, and the first file to "close" (or time out while waiting for more print data from the network) starts printing. EtherMail runs on top of EtherShare, as does EtherPrint, so that you can have EtherMail, EtherShare, and EtherPrint all running on the same machine. EtherMail provides electronic mail for all the users on the system, sets up mailboxes for them on the file server, and can find other users mailboxes on other EtherShares in the network. So EtherShare really becomes a multipurpose server.

IBM Cluster Control Program

IBM gave its "stamp of approval" to IBM PC local networks on March 1, 1984, at the same time it announced the IBM Portable PC.

IBM's Cluster Control Program is designed to be a low-cost, entry-level system, as you will see when you look at the technical specs. (The Cluster Control Program name is somewhat deceiving; "program" refers to the entire system, not to a piece of software.) Compared to other more sophisticated, more mature networks that are available today, I see this system as primitive at best. IBM wanted to design a simple system that could be used by the "average" end user. The company didn't call it a LAN because it didn't want it compared with high-performance LANs.

The Cluster runs at a modest 375K bps (bits per second) and uses a carrier-sense multiple-access protocol with collision avoidance (CSMA/CA). It uses 75-Ω (ohm) CATV-type coaxial cable. You can run the main bus connection as far as 1000 meters instead of the typical 1000 feet, partly because of the modest data rate. The addressing structure allows as many as 64 users per cluster. In practice that number would be far less, depending on the applications and the kind of things you do.

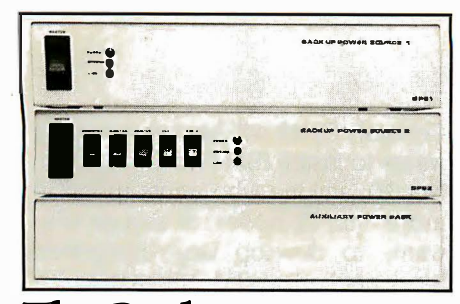
The Cluster supports the IBM PC, PC XT, PC Portable, and the PCjr. There are two different versions of the adapter, one for the PCjr and one for all the other machines. The PCjr adapter plugs into the side of the machine, which, at least in the initial shipments, contains a power supply that is inadequate to power more than the PCjr and the adapter. In order to have the Cluster adapter and a disk drive, printer adapter card, or internal modem plugged in, you must have the power-expansion adapter, which was announced this summer.

The network software requires DOS 2.1 and supports station-to-station communication; you can send files or messages back and forth between users. The package also has some diagnostics to help identify problems (for example, the network card) and it includes disk-server capabilities for the PC XT.

The disk server, like the hardware itself, also supports the IBM microcomputers previously mentioned. It requires a PC XT or a PC made to work like an XT. As an option, the IPL (initial program load) allows you to

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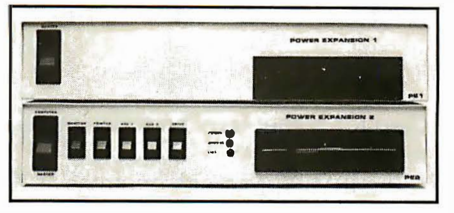
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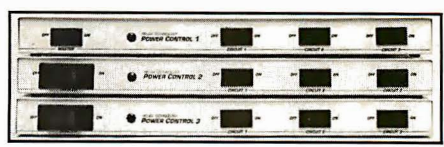
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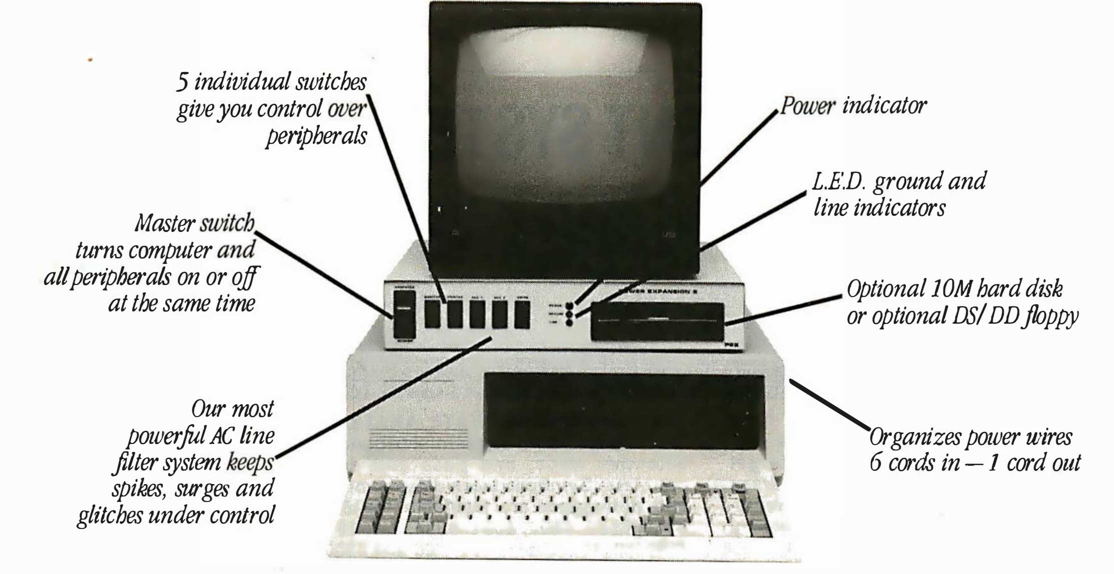
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download the DOS 2.1 operating system from the PC XT right into your workstation; in fact, the PCjr is supported in this way because it does not have a disk drive when it is on the network.

The disk server supports sharing at the volume level and supports only two volumes at one time per user. You can mount only two virtual disk volumes at one time, one of which can be a public volume shared by all users on the system (read only), and the other a user's private volume. However, you'll start seeing more and more sophisticated software to support the system as third-party software vendors jump on the bandwagon.

IBM PC NETWORK

In mid-August of this year, IBM announced its first "real LAN," the IBM PC Network. The PC Network is based on broadband technology developed by Sytek Inc. Sytek supplies the PC Network Adapter Card and the Network Translator Unit, or head end, to IBM. The Network Translator comes with a connector assembly for attaching as many as 8 IBM PCs within a radius of 200 feet. A cabling component, consisting of cable segments, a network-base expander, and various network distance kits, is used to increase the number of networked IBM PCs from 8 to 72. In addition, IBM is an OEM of Sytek for LocalNet/IBM PC protocols, modified Sytek LocalNet 20 protocols that are used in the Adapter Card for higher-level protocol implementation.

The IBM PC Network operates at 2 megabytes per second on one channel of a midsplit broadband system for distances up to 1000 feet. With the components that are available from IBM, the maximum number of IBM PCs supported on the network is 72. These limitations, however, appear to be due to IBM marketing decisions and are not inherent in the design.

The PC Network is designed for the IBM PC, PC XT, Portable PC, and the new PC AT. Unlike the Cluster, it will not support the PCjr. It is being promoted as offering highly reliable, maintenance-free operation and has extensive self-test and diagnostic capabilities.

The Adapter Card for the PC Network uses an Intel 82586 Ethernet data-link controller chip to provide access control. An Intel 80188 microprocessor running at 6 MHz and 16K by 8 RAM (random-access read/write memory) data buffers are used for protocol processing, packet assembly/disassembly, and other control functions. A custom VLSI chip, jointly developed by IBM and Sytek, is used to implement protocols up to Level 5, the session level. Up to 16 active aliases and 32 active sessions are allowed per IBM PC. Release 3.1 of DOS will be required to support PCs on the network.

IBM representatives have stated that the PC Network Adapter Card will work on third-party installed networks. Certainly Sytek will help anyone who wants to install IBM PCs on its LocalNet 20, anyone who wants to install more than 72 nodes, or anyone who wants to develop large integrated local networks. IBM appears to be targeting small businesses, the mass market, and large non-IBM accounts with this product. The Network Adapter Card is currently available, but the network software (DOS 3.1) will not be available until early next year.

IBM has also stated its intention to interconnect the PC Network to its token-ring network (announced, but not commercially deliverable for another two years), and that all PC Network software will also run on IBM PCs directly attached to the token ring. Thus, software developed for the PC Network will not become obsolete when IBM begins to implement its token-passing ring network. However, it is not clear how the Cluster fits into IBM's overall LAN strategy, if at all. One nice application for the broadband IBM PC network would be to support several "subnetworks" of Cluster systems.

ORCHID TECHNOLOGY'S PCNET

Orchid Technology's PCnet is available from a number of different vendors in addition to Orchid. AST's PCnet, Santa Clara Systems' PCnet, and IDEAssociates' IDEAnet are all basically the same system.

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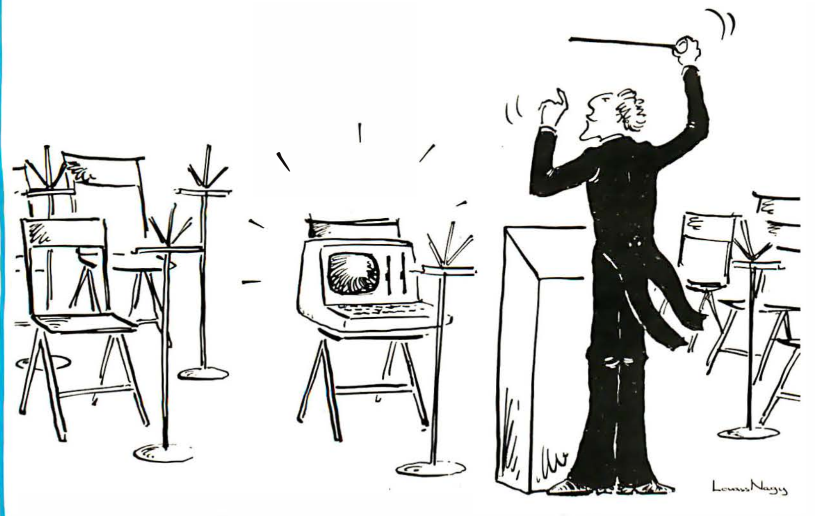
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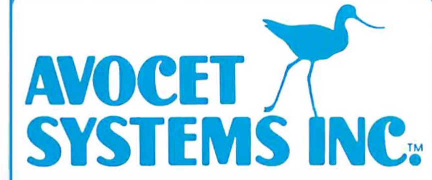
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uses coaxial cable as a transport medium. It also supports collision detection and is software-intensive. The network board has no VLSI or central processor. It requires constant attention from the PC's processor to support all the data-link functions to form the packet, ship it, watch for collisions, etc. Benchmarks for PCnet are beginning to run slower than other systems, due in part to overhead to support the networking function, as well as Orchid's proprietary multiprocess operating system. Again, the network board provides only a physical interface between the IBM PC and the network. It also turns out that PCnet really runs at the raw data rate of 880K bps—not 1 megabit per second, as stated in Orchid's brochures.

PCnet uses 75-Ω CATV-type coaxial cable. It can run as long as 3000 or 7000 feet, depending on the cable type.

PCnet is available with a number of options. You can get a multifunction memory board, some ports, and a diskless board that allows you to boot from the network, eliminating the need for floppy-disk drives at the workstation.

Like most of the other systems, PCnet does not require a dedicated disk server. You can have two different types of workstations: user PCs and shared PCs. User PCs cannot share their peripherals (with the exception of a printer) with other users on the network. On the other hand, you can make your peripherals, such as a hard disk on a PC XT, available to other users.

PCnet supports a distributed semaphore system. The semaphore table is maintained at each and every machine in the system. This also adds overhead to the system because tables at all PCs must be updated when they change. One of the more interesting features on the system is the remote execution command, which allows you, for example, to compile a Pascal program on a remote machine in the network.

You must be careful when sharing peripherals in PCnet. It is possible to mix output on a printer being shared by more than one person because there is no implied semaphore locking: either you have to build a network print utility that uses the distributed semaphore system or you have to have everyone who wants to use a shared printer use a procedure that says, "Try to lock the printer by entering a semaphore lock command from the keyboard before you try to print. If it's in use, try later. Unlock the semaphore when done."

AST now has a lower-cost version of PCnet available called PCnet II, which runs at 800 bps, uses a collision-avoidance scheme, and is software-compatible with PCnet. AST has also developed its own more efficient software for PCnet II.

Ungermann-Bass Net/One Personal Connection

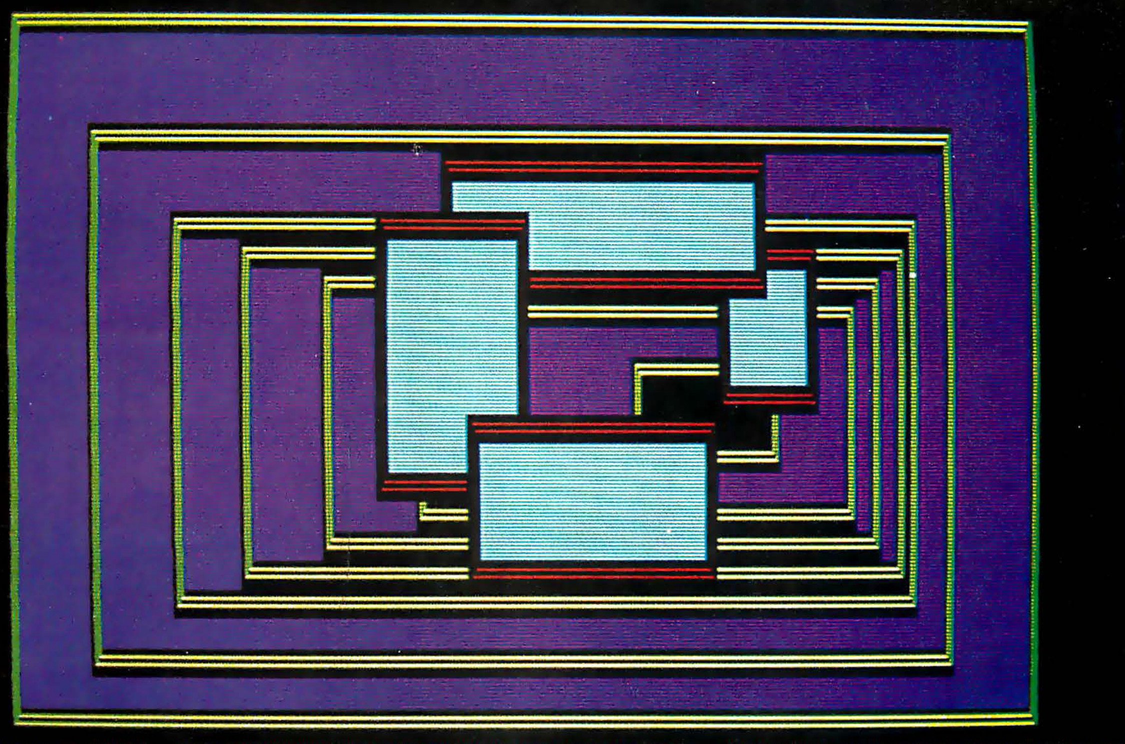
Ungermann-Bass has built a reputation with its Ethernet products, which make up the Net/One product line. These products are basically intelligent boxes that enable you to connect any computer, mainframe, or personal computer to Ethernet. The first products supported terminals in mainframe environments connected via Ethernet, which allowed users to establish virtual terminal connections with a host.

The newest Net/One product is the Net/One Personal Connection for the IBM PC, introduced at the end of last year. This product puts Ungermann-Bass head to head with 3Com; it is aggressively priced as well. It is a true Ethernet system and employs the high-level Xerox Network Systems (XNS) protocols. It is also the first true LAN for PCs to offer a broadband option.

Like most of the other systems based on the IBM PC, the servers are all designed around the PC XT. They are available as a file server, a print server, and an SNA (Systems Network Architecture) Gateway. Multiple servers of the same or a different type are allowed on the same network and do not have to be dedicated.

The network-interface card is called the Network Interface Unit (NIU), a

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board that contains an on-board, high-performance VLSI Ethernet data-link controller from Intel. It also has an on-board, high-performance Intel 80186 microprocessor, 8K bytes of ROM, and 128K bytes of RAM. It requires an external Ethernet transceiver (3Com offers a built-in transceiver). The network interface card is a complete microcomputer on a board, dedicated to handling the XNS protocols and the data-link function. It turns out that this card is more powerful than the IBM PC itself! A less-powerful, less-expensive version is available; it lacks the 80186 and its support RAM and ROM.

A broadband version of the Net/One Personal Connection is totally software-compatible with the baseband Net/One and can also run on existing CATV installations. It runs at 5 megabytes per second and consists of an RF (radio frequency) modem board that plugs into a slot on the IBM PC with a jumper to the baseband board.

Ungermann-Bass entered into an agreement with Davong, through which Ungermann-Bass acquired sorely needed network software to make its system work. Davong has developed a stable networking product called Multilink (also for the IBM PC), which has excellent software to go with it. This will also enable the Net/One Personal Connection to support CP/M-86 and the UCSD p-System, as well as MS-DOS.

Mixing IBM PCs with Other Machines

Let's take a look at two systems that support not only more than one type of personal computer but also more than one type of operating system. So far, all of the systems we've looked at work only with the IBM PC (and some compatibles) and only support the MS-DOS operating system (with the exception of Net/One).

Corvus

Corvus started by selling the first 5¼-inch add-on Winchester drives for personal computers. The first networking product from Corvus was called the Multiplexer, but it was not a true LAN. It was simply a device that allowed you to share a hard disk by partitions. Along came Omninet, a true LAN. Omninet uses CSMA with positive acknowledgment (often called CSMA/PA); hence, Omninet can ensure reliable packet transmission and reception by waiting a brief instant for an acknowledgment from a receiving node after sending a packet. This improves network performance substantially.

Omninet supports more kinds of personal computers than any other network; it has versions for the IBM PC, Apple II, Corvus Concept, TI Professional, DEC Rainbow, and S-100 systems. In addition, a number of other manufacturers are offering it as an option with their personal computers.

The Omninet's address limitation is 63 nodes; once again, the number would be less in actual practice, depending on the applications. And it runs at 1 megabit per second over twisted-pair wire. The total cable cannot exceed 1000 feet without repeaters (an active junction box); up to 4000 feet is possible with repeaters.

The network interface board, called a transporter, contains an on-board 6801 microprocessor to handle the network communication details. It supports DMA as well as interrupts.

Omninet uses a disk server that is actually a single-board Z80-based microcomputer with a built-in network interface. The server is available as a stand-alone box that connects to an external Corvus drive or is built into a 5¼-inch Winchester disk assembly. Corvus is actually the first vendor to integrate a network controller into a disk drive. As many as eight drives with the built-in Omninet interface can be attached to the network.

The software to support networking is called Constellation. The early version was called Constellation I and supported only the Apple II. Constellation II is for IBM and for all the other types of microcomputers. It supports not only different types of PCs but different operating systems as well. On the Apple, you can run Apple Pascal, DOS 3.3, and CP/M; on the IBM PC, you can run DOS 1.1, 2.0, CP/M-86, or the UCSD p-System.

Security on Omninet is minimal. A user name and password are required to boot up a personal computer on the network. Once users are on the network, they must also have access to the volumes they want to use (a "system manager" decides who can access what volumes).

Corvus supplies a Spool utility that enables you to spool files to printers as well as other (compatible or noncompatible) personal computers. Users with the same personal computers can, of course, share the same volumes directly. Again, nothing prevents users from writing to the same file at the same time and corrupting data, but semaphores are available for users or programmers.

Corvus was one of the first companies in the microcomputer network business to recognize a need to back up data. Two years ago it introduced a product called Mirror, which lets you dump a mirror image of a Corvus hard disk to a standard videotape recorder. Corvus also has a product called The Bank, a high-capacity (200-megabyte) tape-cartridge drive that interfaces directly to Omninet. The Bank can be used as a backup to the disk server and can also be directly accessed by workstations in the manner of a slow disk server.

One of the more interesting Omninet products is the SNA Gateway. The Gateway allows workstations to run terminal-emulation software and establish a virtual connection with a remote host. More than one user can use the Gateway at the same time. It supports 3270 terminal protocols as well as SNA/SDLC (synchronous data-link control) communications protocols to the host.

Nestar

Nestar was the first third-party vendor to produce a true personal computer LAN. It was called the Cluster/One Model A for Apple computers, and it made its debut in 1980. The Cluster/One is not being sold anymore, now that Nestar is pushing its PLAN 4000

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system. PLAN 4000 is based on the Arcnet token-passing protocol with XNS protocols at a higher level; it is about four to five times faster than the Cluster/One in end-to-end throughput. In addition, it now supports the IBM PC.

As for the Datapoint Arcnet specifications, the PLAN 4000 network communicates at the raw data rate of 2.5 megabits per second over RG-62 (3270-type) coaxial cable. A VLSI data-link controller (from Standard Microsystems) handles this low-level communication. IBM PCs in this system can be up to 22,000 feet (approximately 4 miles) apart. Active repeaters (equivalent to the Datapoint HUBs), which also connect the workstations to the network, are required every 2000 feet. Each PLAN 4000 can support as many as 254 workstations, but again, a more practical number is lower.

Nestar has preserved a lot of application and server software developed for the Cluster/One and transported it to the PLAN 4000. Because of its early development, Nestar has more servers than any other vendor. These servers include file (actually a disk server), print, 3270, 3278, SNA, telex, file transfer, and gateway (between PLAN systems).

The file server is a high-performance server machine that uses the Motorola 68000 processor and is based on a multibus design. It has a built-in streaming-tape drive for backup, disk capacity of more then 500 megabytes, and a built-in modem port for remote diagnostics. Passwords are supported at the directory and volume levels (the file server supports a tree-like hierarchy of directories and volumes). PC-DOS 2.0 and the UCSD p-System operating systems are supported. With Apple IIs or IIIs, Apple Pascal, DOS 3.3, and CP/M are supported.

Unfortunately, this "Mercedes" of file servers is rather expensive: $20,000 for 60 megabytes of hard-disk memory. A lower-cost version, the PLAN 3000, supports only one disk of up to 60 megabytes. The PLAN 2000 is for OEMs and is essentially a board-level product that includes software for a disk server based on the PC XT.

The gateway server is currently unique to Nestar among the personal computer network vendors. It allows real-time communication between two PLAN 4000 networks. For example, they might be on two different floors. You can actually transfer data at 2.5 megabits per second between systems; in fact, if you had two PLAN 4000 systems with a gateway server, you could establish virtual connections with disks on other network file servers and use them as if they were local. Nestar overcomes the addressing limitation by assigning each network interface card that ships out of the factory a unique Ethernet address (Ethernet has a 48-bit address space, so each manufacturer can have its own portion of it). This address is used by the gateway. So you can actually have two stations on two different networks with the same Arcnet address, differentiated by their Ethernet address. The gateway does support the connection of more than two systems.

SOFTWARE

Personal computer LANs have some interesting capabilities that tend to not make software manufacturers happy. If you take your application and load it onto a hard disk or a shared disk, everybody on the network can run it. Manufacturers, at least until now, have licensed their software to run on a single central processor.

As LANs become more prevalent you will begin to see software manufacturers offering network-wide licensing strategies. Rather than charging the price of 10 copies of VisiCalc to

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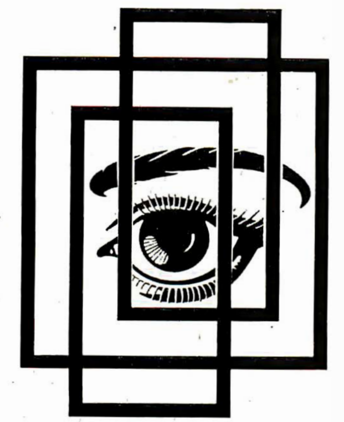
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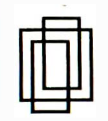
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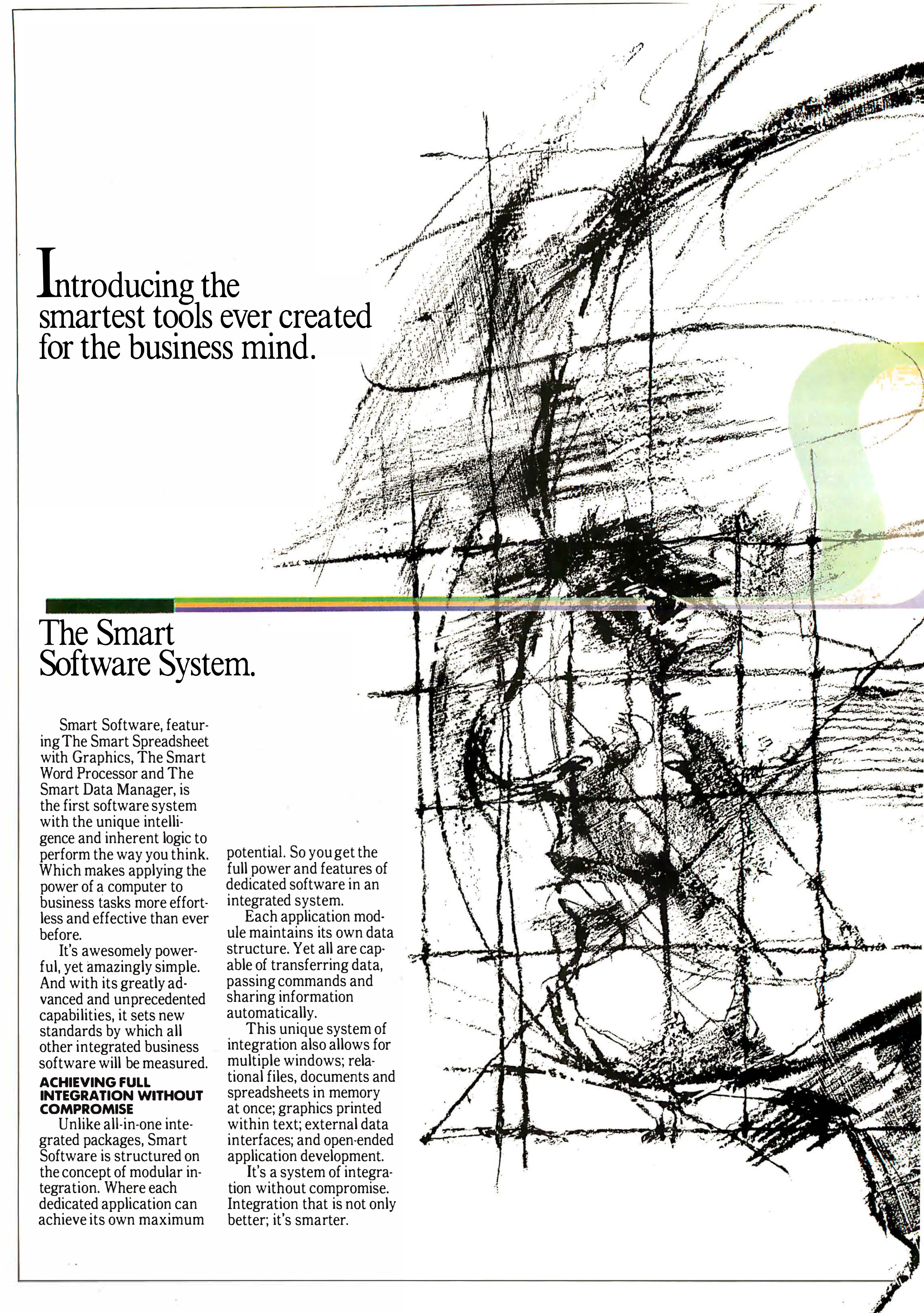
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use it on a 10-node network, the company can charge you for two or three copies and give you a network-wide license. 3Com, for example, already offers network licenses of VisiCalc and VisiFile. Application vendors are also coming up with schemes (sometimes in concert with vendors of LANs) to control the number of copies of one program running at one time.

Operating Systems

A number of software houses are beginning to offer network-operating systems that will operate on a number of different personal computer local networks. These vendors include Softech (Liaison), Novell (NetWare/OS), Digital Research (DR Net), Applied Intelligence (PC/NOS), and Phoenix Software (PAXNET).

Let's take a closer look at Digital Research's DR Net and Novell's NetWare/OS.

Digital Research DR Net

DR Net (available by the time this article is published) is going to preserve compatibility, at least at some level, with all the CP/M operating systems. The various operating systems are going to have different roles to play in the DR Net system. As with the other network-operating-system vendors, Digital Research would like to see an operating system for a wide variety of networks with a user interface that remains unchanged, so users don't really care which network they are on.

Because Digital Research preserved compatibility among all versions of CP/M, 8- and 16-bit systems can in fact share the same files on the same network.

The basic idea of DR Net is illustrated in figure 1. The NDOS, a cap on top of the operating system, performs as a true file server rather than a disk server. NDOS takes a look at each DOS request that comes through. If it's for a local peripheral, the request is passed down to the local operating sytem and through the local I/O system. When it's a request for a virtual peripheral, it's shipped over to the network I/O system and straight out to the network hardware. From there it goes out to a server, comes back to the requester, and passes back to the application. As many as 16 users can be supported at a server simultaneously. And because it's a file server, users are able to put password protection on individual files.

Digital Research did, in fact, put record-locking facilities into some of its earlier operating systems, particularly MP/M. And it has included those on the CP/M-86 and Concurrent CP/M-86 products. So you can have multiuser file sharing with record locking. And because this is built into the operating system, the application programs don't necessarily have to use a semaphore scheme to support a multiuser application.

Some of the operating systems, particularly the more primitive ones, can only be requesters. For instance, CP/M-80 and CP/M-86 are basically only requester operating systems; MP/M, on the other hand, whether 8-bit or 16-bit, actually was designed to provide file sharing to CP/M systems.

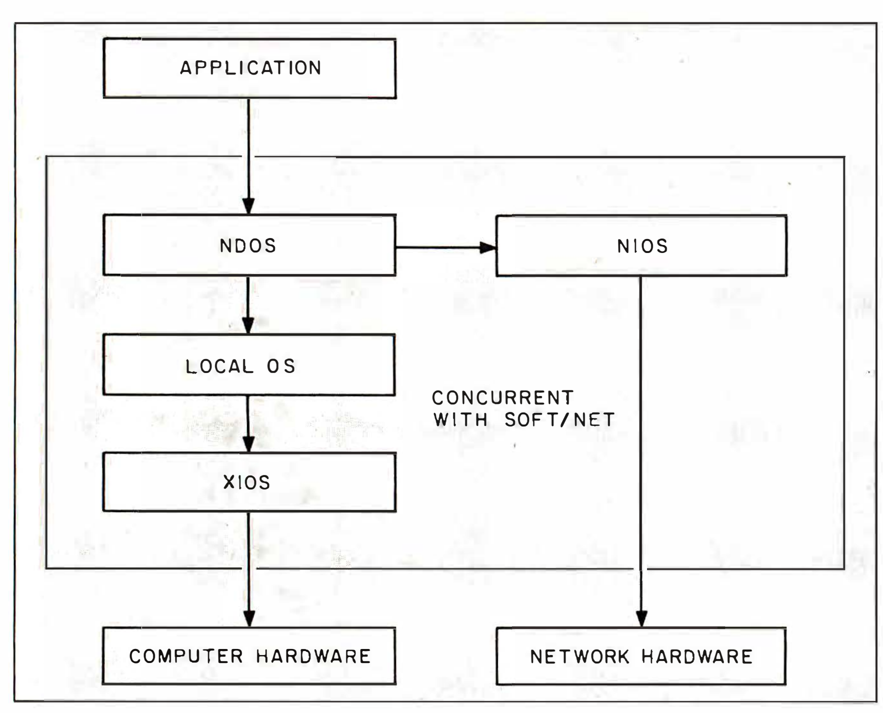


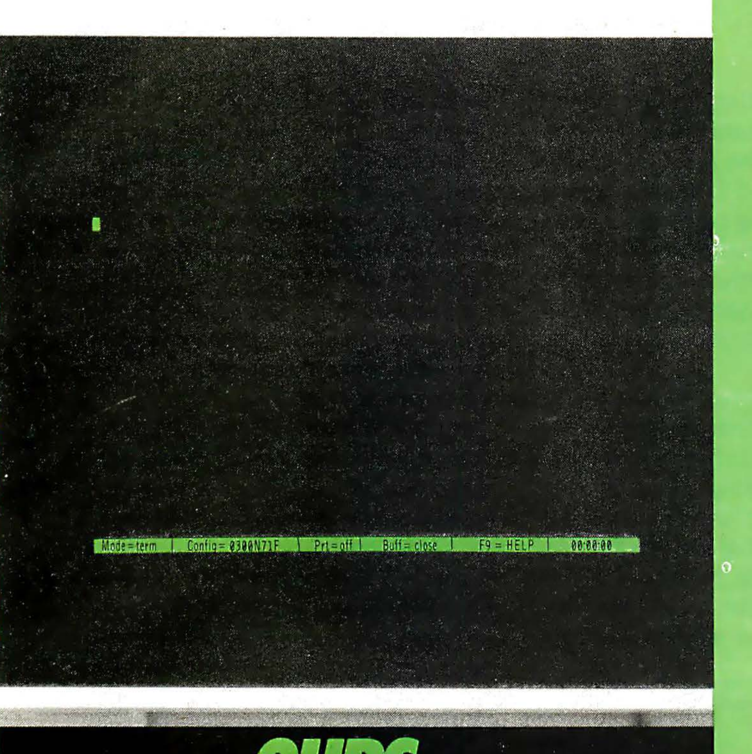
Figure 1: *The structure of* DR Net, *in which* NDOS *is a true file server.*

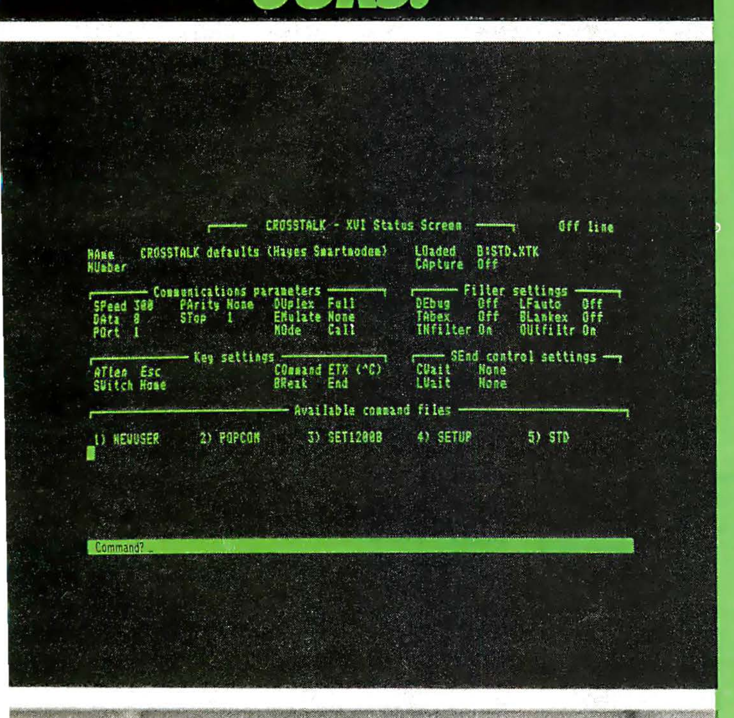
Novell NetWare/OS

Novell NetWare/OS software is portable across a number of different networks. Novell currently has eight different versions of NetWare, applying to different network hardware. The versions are NetWare/D for Davong's Multilink, NetWare/E for 3Com's EtherLink board, NetWare/G for Gateway's G-NET (also referred to as the Novell NetWare/X system), NetWare/N for Nestar's PLAN 2000, NetWare/O for the Omninet transporter, NetWare/P for Proteon's proNET token-ring system, NetWare/PC for Orchid's PCnet, and NetWare/S for Novell's NetWare/S system. All of these systems use the PC XT (with the exception of NetWare/S, which uses a 68000-based file server) as a (true) file server.

One thing to keep in mind is that you cannot mix and match NetWare with the other vendors' server products and have them communicate with each other. Although one of the nicest file servers around, NetWare is a highly proprietary, closed system. The search for a system that integrates everyone's networking hardware and software goes on.

(continued)





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Its unfortunate that all of the IBM PC LANs *are incompatible with each other.*

Let's take a look at some of the capabilities of the NetWare/OS file server. NetWare puts a cap on top of DOS, much like DR Net. NetWare implements a number of functions in the server to increase its performance. For instance, it dedicates a large portion of memory as a disk cache and performs elevator-seeking on the hard disk. You can queue up requests, and as they process, they will move the heads on the hard disk like an elevator so that the heads won't be thrashing back and forth. The heads move by processing pending requests in an order that minimizes disk-head movement. Currently, only one server is supported per network, but it can be used in a dedicated or nondedicated mode.

On the PC XT server Novell put in its own multiprocess operating system, as illustrated in figure 2. A lot of processes are taking place at one time. For instance, server processes are provided so that six pending requests are possible. NetWare/OS has a disk read/write process that manages the cache. It also writes out blocks that have been modified and are sitting in the cache. Print spooling is a background task that can support as many as three printers at the server (PC XT). NetWare/OS also has a console-handling process that supports a wide variety of commands that you can enter from the console at the server itself. All these processes interact to form the NetWare/OS file (and print) server.

Because NetWare/OS is a true file server, a file can be automatically locked while it's open so that the server won't let somebody else open the same file. Another interesting feature is a broadcast command that can be entered at the console or user's personal computer. This lets a user send a one-line message to the other active stations on the network; it will appear on the twenty-fifth line of the personal computer's display.

Figure 2: *Novell's own multiprocess operating system in* NetWare/OS.

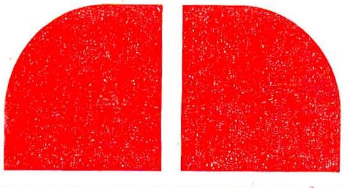
Conclusions

It's unfortunate that all of the IBM PC LANs are incompatible with each other and that many use highly proprietary software. Eventually, there is going to be a shakeout, and survival for some vendors may mean revamping their product lines or building gateways to the more "accepted" personal computer LANs. It's also unfortunate that so many vendors have a lot of hype in their advertising and marketing. And users may find that, in the long run, inexpensive systems actually cost more in terms of lost productivity due to poor response times when several personal computers are involved.

There are still several missing pieces to IBM PC local networks (which can be found in mainframe systems), such as system accounting functions, performance monitoring, and management tools. And standards are lacking at all levels, although more and more vendors are implementing de facto standards.

I'd like to conclude with six cautions. First, be leery of vendors' performance claims. Raw data rates of the network can be deceiving if the system has poor hardware and complex

(continued)





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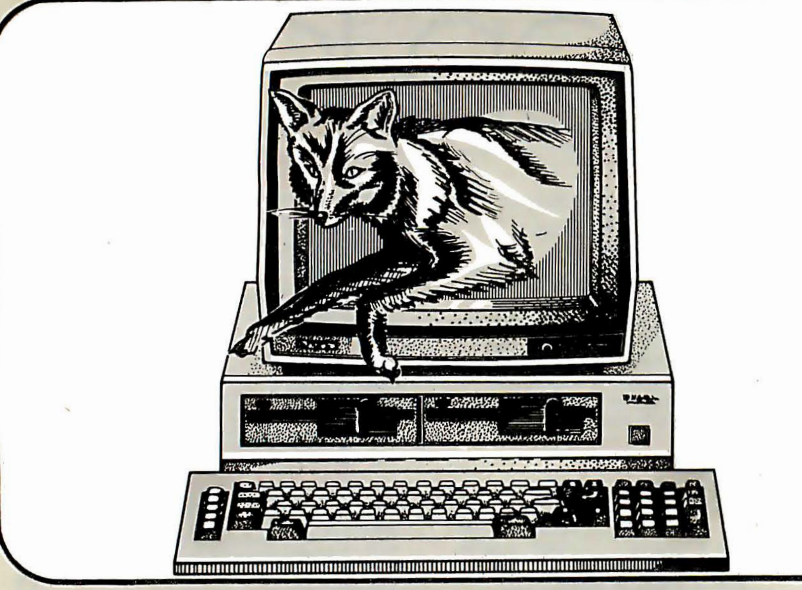
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software to support it.

Second, beware of the "low" cost: $500 to $800 per connection may not be the dominant cost when you consider that every networking system will have at least one shared hard disk, which is typically a $6000 PC XT. And recall that installation of the cable typically costs far more than the cable itself.

Third, watch out for software integrity. Some networks introduced a year or so ago still have bugs. Also, the more "distributed" types of systems (sharing any personal computer's resources anywhere on the network) tend to be shaky because of the complexity of the multitasking networking software. And these systems typically require 64K to 128K more bytes of RAM for every personal computer than the "nondistributed" types.

Fourth, don't be surprised if your favorite stand-alone software package doesn't run on a local network. These packages are designed for stand-alone personal computers, are often copy-protected, often make assumptions about the local environment, and are clearly not designed for multiuser environments. However, most software that uses standard BIOS calls works satisfactorily when used in a network, provided that users aren't manipulating the same files.

Fifth, watch out for conflicts between the network board and other add-on boards. There are only a few DMA and interrupt channels in the IBM PC, and many third-party vendors use them. So don't be surprised if you have to remove your favorite hardware board as well!

Finally, no system available today is truly turnkey. For example, the vendors don't tell you about the hidden costs in a system such as personnel costs. Somebody has to install that network. People have to be trained. Someone has to maintain and manage the system. ■

This article is based on the upcoming Architecture Technology "Personal Computer Local Networks Report," which will be available at the time of this printing.

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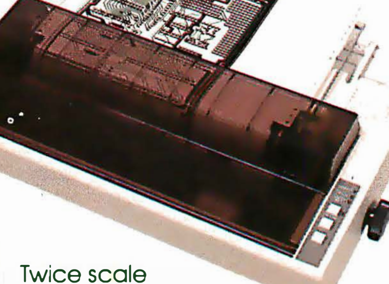
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What makes smARTWORK™ so smart is that it understands electrical connections. Conductor spacing is always correct, lines don't become too narrow, and connecting lines do not intersect other conductors. smARTWORK™ can automatically find and draw the shortest route between two conductors. Or you can specify the route.

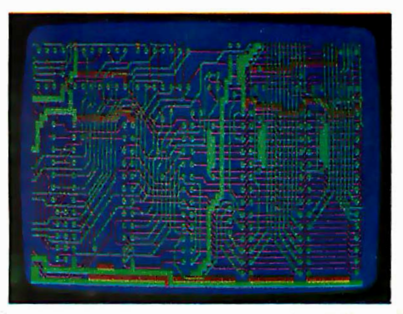


smARTWORK™ is the only low-cost printed-circuit-board artwork editor with all these important advantages:

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- ☐ Easy to learn and operate, yet capable of sophisticated layouts
- ☐ Single-sided and double-sided printed-circuit boards up to 10 x 16 inches
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- ☐ Can use optional Microsoft Mouse as pointing device



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- ☐ IBM Color/Graphics Adapter with RGB color or b&w monitor
- ☐ Epson MX-80/MX-100 or FX-80/FX-100 dot-matrix printer
- ☐ Houston Instrument DMP-41 pen-and-ink plotter (optional)
- ☐ Microsoft Mouse (optional)

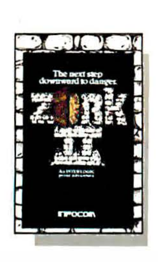


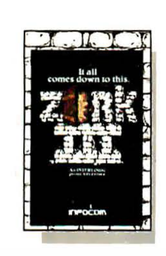
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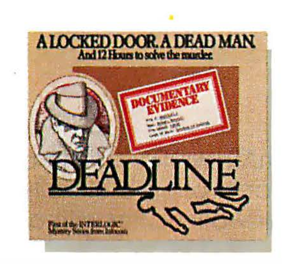
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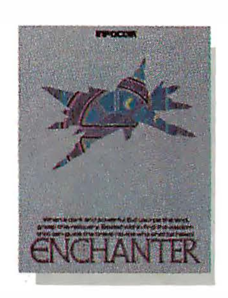

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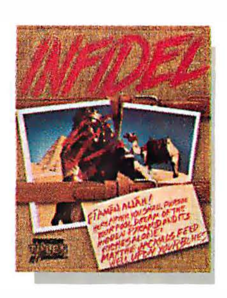

The WITNESS
SOMEBODY'S GOING TO TAKE THE DEEP SIX!

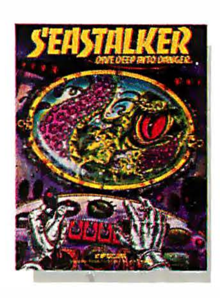

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AND NOW FOR SOMETHING INCOMPLETELY DIFFERENT!

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The real reason is: an Infocom work of fiction can never be complete until you become a part of it.

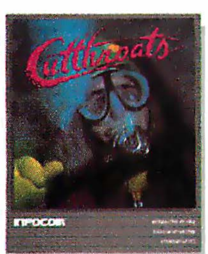
You see, as hard as we work at perfecting our stories, we always leave out one essential element—the main character. And that's where you enter in.

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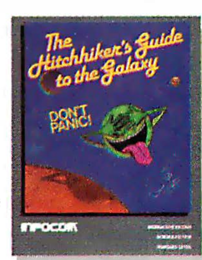
But there is this key difference between our tales and conventional novels: Infocom's interactive fiction is active, not passive. The course of events is shaped by the actions you choose to take. And you enjoy enormous freedom in your choice of actions—you have hundreds, even thousands of alternatives at every step. In fact, an Infocom interactive story is roughly the length of a short novel in content, but because you're actively engaged in the plot, your adventure can last for weeks and months.

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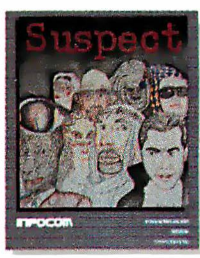
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212A Modem Comparison Chart*

STANDARD FEATURES	PRO	HAYES STACK	NOVATION SMARTCAT+	ANCHOR 1200	US ROBOTICS PASSWORD
300/1200 Baud (212A)	✓	✓	✓	✓	✓
Intelligent Microprocessor	✓	✓	✓	✓	✓
Tone and Pulse Dialing	✓	✓	✓	✓	✓
Hayes Command Compatible (Works with Smartcom™)	✓	✓	✓	✓	
Additional telephone jack with exclusion switching	✓				
Analog loop back self test	✓	✓	✓		
Self Test at Power Up	✓		✓		
Call Progress Detection (Busy, Dial Tones, Trunk Busy, etc.)	✓		✓		
Speaker and External Volume Control	✓	✓	✓		
Full Complement of Status Lights	✓	✓			
8 Switch Selectable power-up defaults	✓	✓			
Adaptive Dialing	✓		✓		
Auto Redial on Busy	✓		✓		
Ergonomically designed easy to read front display panel	✓				
Internal Stand-Alone Power Supply	✓				
Built in Real Time Clock/Calendar	✓				
Help Command	✓				
300 baud connect while maintaining 1200 baud RS-232 link	✓				
EXPANDABLE OPTIONS					
Automatic Receiver Buffer	✓				
Automatic Transmit Buffer	✓				
On-board Personal/Business Directory	✓				
Buffer, Expandable to 64K	✓				
Auto Logon Macros	✓				
Auto message transmission to groups of numbers	✓				
Records call duration	✓				
12-character Alphanumeric Display	✓				

*Comparison made by Prometheus on the basis of the best information available to Prometheus at time of printing.



HIGH-SPEED DIAL-UP MODEMS

BY KIM MAXWELL

The promise and peril of faster data transmission

Editor's note: "Baud" and "bits per second" are often used interchangeably and, as an imprecise indicator of speed, you can probably get away with using either term since it's such a widespread practice. In actual fact, however, baud is an indicator of symbols per second on the telephone line where the symbols can have more than two states. Bits per second refers to the information rate between the terminal and the modem. In this article, Mr. Maxwell uses baud and bits per second in their precise meanings.

MODEMS ENABLE transmission of computer data over ordinary telephone lines. Modems today cover a vast range of speeds, but the most common types are very slow. At least 70 percent of all modems are used on the switched-telephone network. Two types predominate among switched-network units: AT&T (Bell) 103 compatibles for speeds up to 300 bps (bits per second) and AT&T 212 or Vadic 3400 types for speeds up to 1200 bps. Faster modems for the switched network—at 2400, 4800, and even 9600 bps—have been produced, but they are not in general use because they require unusual protocols or simply cost too much. For leased or dedicated lines, modem speeds have reached as high as 14,400 bps.

THE SPEED FACTOR

For certain applications, speeds higher than 1200 bps are either desirable or mandatory. I will discuss some of these applications, examine why it is difficult to make modems faster, and then look into the technological future for some indication of things to come. First, though, let's develop some practical understanding of speed. Because each character sent from a computer requires 10 bits, 300 bps translates to 30 cps (characters per second), and 1200 bps translates to 120 cps. A fast typist snapping out text at 100 words per minute produces data at approximately 10 cps, or 100 bps. The average person can read text traveling across a screen at 300 bps, and a speed reader might be able to follow 1200 bps if he didn't blink.

Standard modems, at 300 and 1200 bps, handle applications at keyboard or reading speeds nicely. Calling a bulletin board, reading electronic mail, looking up a stock report, entering information into a database, or doing a simple database inquiry requires no more speed than is currently available. But what happens when you try to transfer files, fill a screen from a remote computer, send long documents, or create graphics? Time becomes more critical. For comparison, let's develop the time required at various speeds to send a full screen, a full floppy disk, and Herman Melville's novel *Moby Dick*.

An 80-character by 25-line screen displays 2000 characters, which is also the approximate number of characters in a single page of double-spaced text. A floppy disk contains about 356,000 characters, and *Moby Dick* has approximately 2.5 million characters. Table 1 gives the time required to send each unit at standard data rates ranging from 300 to 9600 bps.

What does this arithmetic mean to users? A salesperson on the road who needed to download a disk's worth of applications programs and data from the home office would spend more

(continued)

Kim Maxwell, president and founder of Racal-Vadic (1525 McCarthy Blvd., Milpitas, CA 95035), developed the first full-duplex 1200-bps modem. He received his bachelor's degree in philosophy from Stanford University.

← Circle 315 on inquiry card.

Seldom, if ever, is data sent and received simultaneously.

than two hours in communications before she could start working with the information if she used the standard 300-bps modem built into current portables. However, if she used a 9600-bps modem, she could accomplish the same job in less than 10 minutes.

Consider a programmer using his personal computer at home as a terminal for interactive programming on his corporate computer, and the system sends full screens rather than single characters (very typical today, given IBM's preference for full-screen communications). At the common speed of 1200 bps, he waits 17 seconds per screen, which is intolerable and virtually precludes home programming. An economical 4800- or 9600-bps modem would make programming at home possible for many computer professionals. For situations like this, increased speed means a direct increase in productivity.

While sending character files and screens creates problems for slow-speed modems, transmitting graphics over dial-up lines can be staggering. In some full-color graphics systems, each pixel requires 16 bits; a screen of 150,000 pixels requires 2.4 million bits. Painting a screen under these circumstances takes 33 minutes at 1200 bps and 4 minutes at 9600 bps. Of course, simpler systems, such as black and white with one or two levels of gray, go much faster. But even at 2 bits per pixel, a 1200-bps modem paints a screen in 4 minutes, while a 9600-bps modem gets it done in 30 seconds.

So why aren't faster modems used? Cost, technology, and compatibility. Table 2 lists the prevailing standard and the 1984 cost range for switched-network (full-duplex, explained later) modems from 300 to 9600 bps.

Current Standards

Compatibility only concerns signals on the telephone line, but it is vital to assure intercommunication between modems made by different companies. Bell established de facto standards at 300 and 1200 bps, and these modem types are widely supported by data networks such as Tymnet and Telenet. The standard at 2400 bps was established by an international standards group called CCITT (Consultative Committee on International Telephone and Telegraph), which is an agency of the United Nations. Bell (now AT&T-IS [Information Systems]) helped write V.22 bis (bisynchronous) and V.32 and has announced its 2400-bps modem in compliance with the CCITT recommendation. However, no major network offers dial-in service at 2400 bps on a widespread basis yet. Only one company markets a product in this country at 4800 bps, and it conforms to no international or accepted national standard. Although no commercial V.32 modems are currently available, you can expect to see some in 1985. They will cost several thousand dollars each, and you will need two of them.

For several years surveys of modems available have included 4800- and 9600-bps modems from many reputable manufacturers. Why can't they be used on the switched network, instead of waiting for V.32 or something else to be invented? Two terms supply the answer: "two-wire" and "full-duplex." While the bulk of switched networks comprises carrier systems that use separate paths to send and receive signals, the end connection to a modem or telephone uses a single two-wire line that carries signals in both directions. Higher-speed modems listed in recent surveys were designed for leased lines, which usually bring two two-wire lines, or a so-called "four-wire" line, to the modem, creating separate signal paths for sending and receiving data.

Full-duplex means having the capability of sending and receiving data in both directions simultaneously. (Note that a two-wire line is inherently full-duplex. You can talk and listen at the same time; the brain separates the mouth from the ear.) For historical reasons, modems used on the switched-telephone network must be full-duplex if they are expected to operate in a general-purpose environment. That fact is both sad and ironic.

(continued)

Table 1: *The transmission times for various documents at different baud rates.*

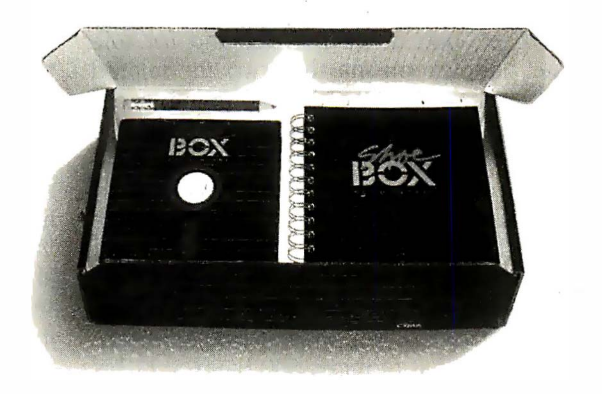
Speed (bps)	Screen	Floppy Disk	Moby Dick
300	66 sec	3.2 hr	23 hr
1200	17 sec	48 min	5.75 hr
2400	8.3 sec	24 min	2.9 hr
4800	4.2 sec	12 min	1.4 hr
9600	2.1 sec	6 min	43 min

Table 2: *Approximate cost of different speed full-duplex modems.*

Speed (bps)	Standard	Cost Range
300	AT&T 103	$60–$350
1200	AT&T 212	$450–$700
2400	V.22 bis	$800–$1400
4800	none	$2500
9600	V.32	n/a

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Echo cancellation rescues the received signal from the transmit signal.

Seldom, if ever, is data sent and received simultaneously; typically, communication is half-duplex—sending, then receiving, then sending, and so on. And given appropriate protocols and buffer management, half-duplex modems would work fine on the switched-telephone network.

FULL-DUPLEX TRANSMISSION

But terminals were initially connected to computers directly, with separate paths to send and receive data. Communications interfaces and software therefore assumed a full-duplex connection. The first switched-network modem, introduced by Bell in the early sixties, provided full-duplex operation by dividing the telephone line into two subchannels, sending in one channel and receiving in the other. Communications interfaces and software did not have to change in order to be used with Bell's first modem. The cost of converting all the networks, computers, and terminals now installed to half-duplex would be prohibitive.

So switched-network modems (generally) must provide full-duplex data transmission over two-wire circuits that have a frequency range (bandwidth) from 300 to 3400 Hz. How? First, the modem modulates a carrier; that is, it changes the state of a carrier signal, in different ways for different modems. The modulated signal requires a bandwidth (measured in Hz), or range of frequencies, greater than the rate of change (modulation) of the carrier (the baud rate). A 300-baud modem needs at least 300 Hz, a 1200-baud modem needs at least 1200 Hz, and a 9600-baud modem needs at least 9600 Hz. But the switched network only provides 3100 Hz of bandwidth. How can 9600 bits per second possibly squeeze through? By recognizing that modulation can be far more complex than simply switching between two frequencies to send 1s and 0s. For example, you can switch among 4 phases, or 8 phases, or even 16 phases of a carrier. If you use 16 phases (or states defined some other way), you can organize input data into groups of 4 bits and assign 1 phase to each group. Now the carrier can change state at 2400 baud while the incoming data can be going 9600 bps, and it fits.

Fitting, of course, is not quite enough, since the demand for full-duplex means that two modulated carrier signals must fit, going in opposite directions. Modems up to 2400 bps create full-duplex communications the way Bell did originally, by dividing the line into two separate channels. The cost, though, is speed. To squeeze two 1200-bps channels into one line, Bell (and Vadic before it) used a four-phase modulation system that requires 600 baud. V.22 bis modems also use 600-baud channels for 2400 bps. The 4800-bps modem mentioned above actually sends data in a band that overlaps the receive band; interfering signals are suppressed by a technique known as echo cancellation. Modems compatible with V.32 send and receive 9600 bps (at 2400 baud) in the same band, at the same time. Again, echo cancellation rescues the received signal from the interfering transmit signal.

Table 3 gives the baud rate and carrier states for the standard modems available today or expected soon. As bit rates increase, so does complexity, in geometric proportion. More carrier states dictate more sophisticated demodulators. At 2400 bps and above, the modem requires an adaptive equalizer to counteract effects of poor-quality telephone lines. Echo cancellation at 4800 and 9600 bps nearly doubles the signal processing requirements. A V.32 needs to perform 2.4 million multiplications per second; an IBM PC can produce about 100,000 per second.

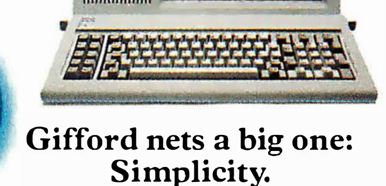
But as indicated by prices of computers and memory, increasing complexity has not deterred progress. Affordable prices follow in due time. Until two years ago, no one manufactured a single-chip AT&T 103 modem, the simplest variety in general use. Now several semiconductor companies offer them. By the end of 1984, at least one single-chip 1200-bps modem that is both AT&T 212- and Vadic 3400-compatible will be available in small quantities, along with several implementations using two or more chips. Some of the multichip versions include the AT&T 103 and dialing circuits. Several more single-chip versions should surface during 1985 and 1986 from semiconductor companies and modem manufacturers.

In 1985 modem manufacturers like Racal-Vadic will visit upon the world two- or three-chip versions of V.22 bis for 2400-bps operation, using a commercial or custom signal processor and custom VLSI (very-large-scale integration). We will also unleash V.32, but probably not inexpensive enough for the casual personal computer user. They will cost more than the personal computer itself, but the investment will be worth it for many professionals. ■

Table 3: *Baud rate and number of carrier states for common modem bit rates.*
**V.32 modulation includes redundancy for error correction.*

Bit Rate (bps)	Baud Rate	Carrier States
300	300	2
1200	600	4
2400	600	16
4800	1200	16
9600	2400	32*

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Prevents duplicate entries	Yes	No	No
Data field masking	Yes	No	Yes (1)
Lookup file capabilities	Yes	No	Yes (1)
Maximum capacities			
Files open concurrently	No limit	1	2
Data-entry forms per file	No limit	1	1
Records per file	65,535	65,534	65,535
Fields per record	255	127	32
Characters per record	8000	1024	1000
Characters per field	255	127	254
Active index keys	255	1	7
Quick report generator	Yes	Yes	Yes
Complex report writer	Yes	Yes	No
Color capabilities	Yes	No	(2)
Uses IBM PC function keys	Yes	No	No
Program file disk space needed	590K (3)	270K	96K
Random-access memory required	192K	128K	128K
List price	$595	$650	$495
Available formats	Most 16-bit	Most	Most
Format tested	PC-DOS	PC-DOS	PC-DOS
Version tested	2.10	2.11	2.40

NOTES: (1) Requires programming. (2) Very limited capabilities, requires programming. (3) Program files may be located on more than one disk.

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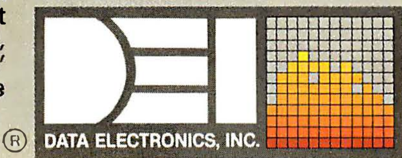
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WRITING COMMUNICATIONS IN BASIC

BY BARRY J. ARNOW

Easy terminal emulation and file transfer

ALTHOUGH THERE ARE a considerable number of off-the-shelf packages to link microcomputers, as well as many for linking microcomputers to mainframe computers, even the most user-friendly programs can be confusing if you lack the appropriate communications knowledge. Experienced programmers on both the microcomputer and the mainframe sides often lack fundamental information in data communications. For this reason, some of the buzzwords are defined in the accompanying glossary.

The rather sophisticated configuration in figure 1 illustrates the use of several sets of terminals linked via terminal controllers to a special front-end computer that handles the communications. These communications links to the front-end processor can be made through any number of media. Though the future promises such technological wonders as optical fibers and laser data transmission, most current links use ordinary telephone lines, either dedicated or regular switched (dial-up lines). Essentially there are three possible methods for modulating a signal over a telephone line. Representing each signal as a wave, you can either change the frequency, modify the amplitude, or perform a "phase shift," which is a sudden jump to another point on the wave.

The most widely used technique for modulation is the frequency shifting of Bell 103 and compatible modems. In this method, the originating station uses frequencies of 1070 Hz and 2225 Hz for 0s and 1s, respectively, while the answering station uses 2025 Hz for the 0s and 2225 Hz for the 1s.

The BASIC programming I discuss here is for asynchronous, as opposed to synchronous, communications. Variations in the asynchronous protocol, such as 7- or 8-bit characters, parity used, and the number of stop bits, must be established for communications to take place. (The problems associated with packaged software generally occur in these variations. The defaults might vary from package to package, and the user might not know how to supply the required information.)

Barry J. Arnow (31 Marshall Dr., Edison, NJ 08817) is a professor of computer science and does consulting in microcomputer training and communications-software development. He has a B.A. from Temple University, an M.S. from the University of Akron, and a Ph.D. from Rutgers University.

DUMB-TERMINAL EMULATION

Microcomputers can be used in communications because they can emulate terminals. Once this emulation is established, you can easily extend programs to transfer files and perform uploading and downloading with mainframes.

The logic for terminal emulation is depicted in the flowchart in figure 2. The host or front-end computer expects to receive certain control characters in addition to the data characters. The BASIC program in listing 1, which runs on an IBM Personal Computer (PC), illustrates a standard use of such control characters. The terminal sends the character, which is stored with an ASCII (American Standard Code for Information Interchange) code 19 in the variable XOFF$, to the host or front-end com-

(continued)

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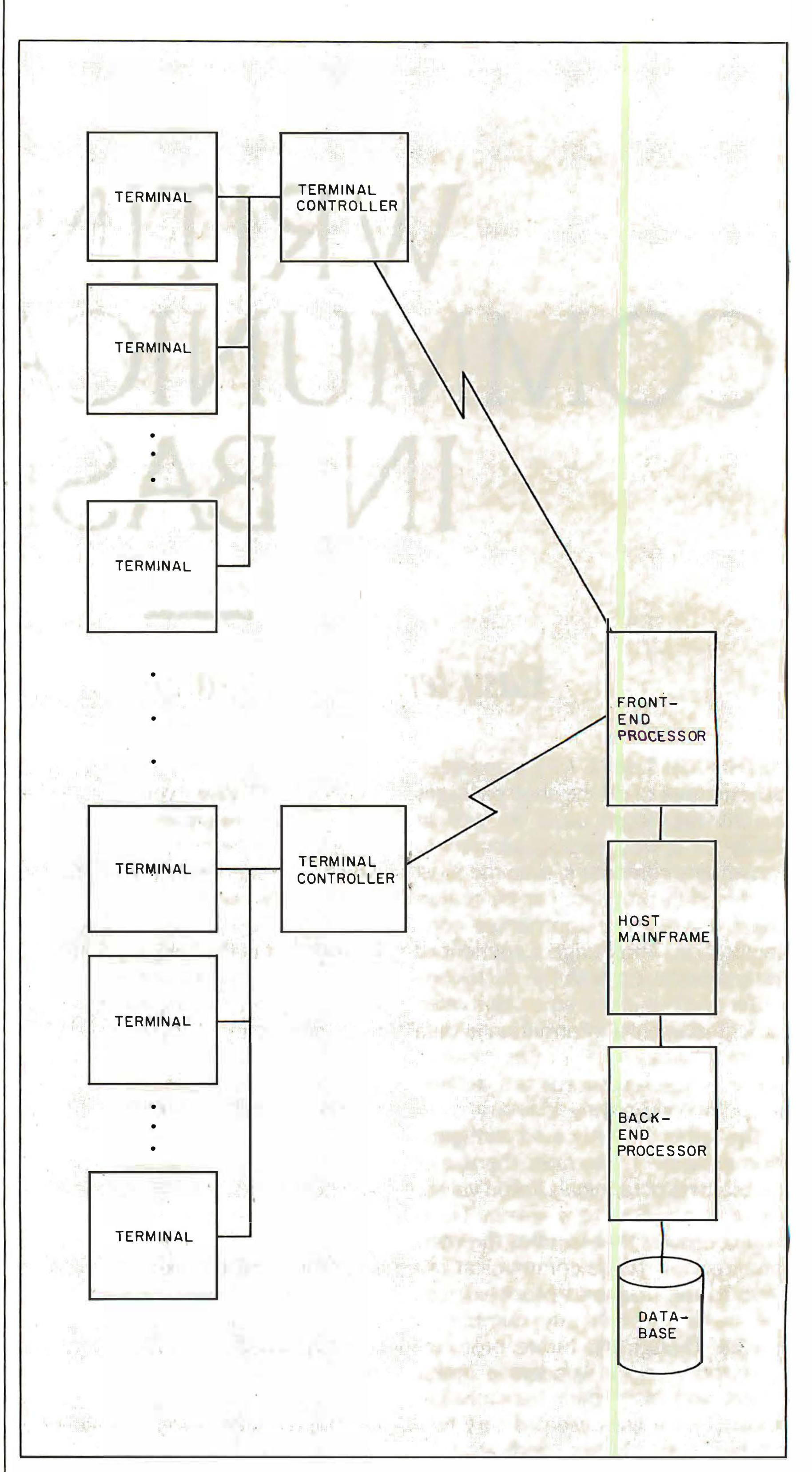


Figure 1: *System configuration illustrating the use of more than one set of terminals linked via terminal controllers to a front-end computer handling communications.*

puter when the receiving buffer contains more than 225 characters. The computer is expected to recognize the XOFF$ and to stop transmitting so that the terminal can catch up. When the receiving buffer is empty, the terminal tells the computer to resume transmission by sending it an XON$ or an ASCII code 17. The host or front-end computer may in turn send these and other control characters after every line of data, making it necessary for the terminal to edit incoming information.

At speeds of 1200 bps (bits per second) or less, it is unlikely that the receiving buffer will ever have more than 225 characters. If it does, however, you can increase its 256-byte default size when you activate BASICA on the IBM PC. Needless to say, a tightly coded and efficient program is very important in terminal emulation. It becomes even more crucial when such programs are enhanced to send and receive files since the I/O (input/output) performed slows the programs considerably.

FILE TRANSFERS

The terminal-emulation program in listing 1 reads the data being sent to the host or front-end computer from the keyboard and displays the incoming data on the screen. To send an existing data file from a disk, you must change the program statement that reads the keyboard entry so it reads the disk file instead. Similarly, to receive a file from another computer, the terminal program must write incoming data to a disk file as well as to the screen. Essentially, all that separates file-transfer programs from terminal-emulation programs is reading from or writing to a disk rather than a keyboard or a screen. However, some kind of coordination is necessary between the sending and the receiving programs. You may—in fact, you should—include error-checking and error-handling routines as part of the protocol, but they are omitted from the listings here for the sake of simplicity.

The flowcharts in figure 3 and the corresponding BASIC programs for the IBM PC in listings 2 and 3 detail the minimum ingredients for a file transfer. The sending program waits for a prompt from the receiving program before transmitting a record.

(continued)

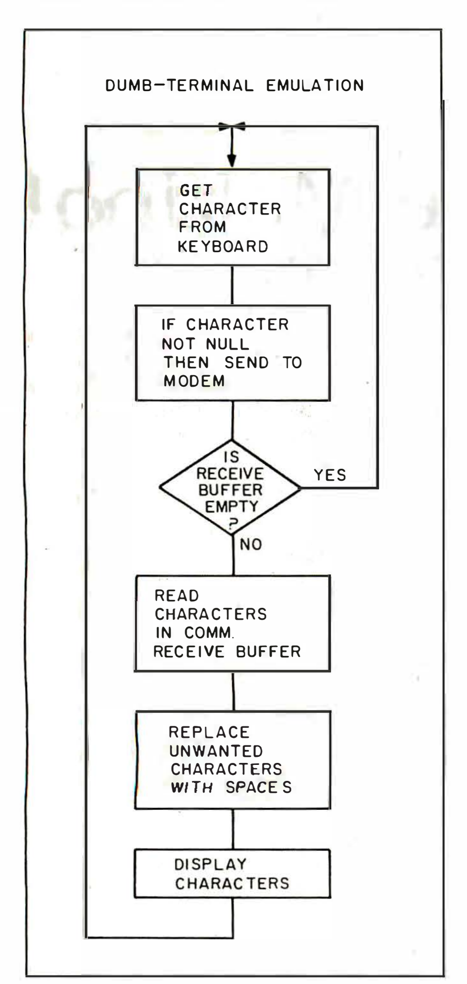


Figure 2: *A flowchart of the logic for terminal emulation. See code in listing 1.*

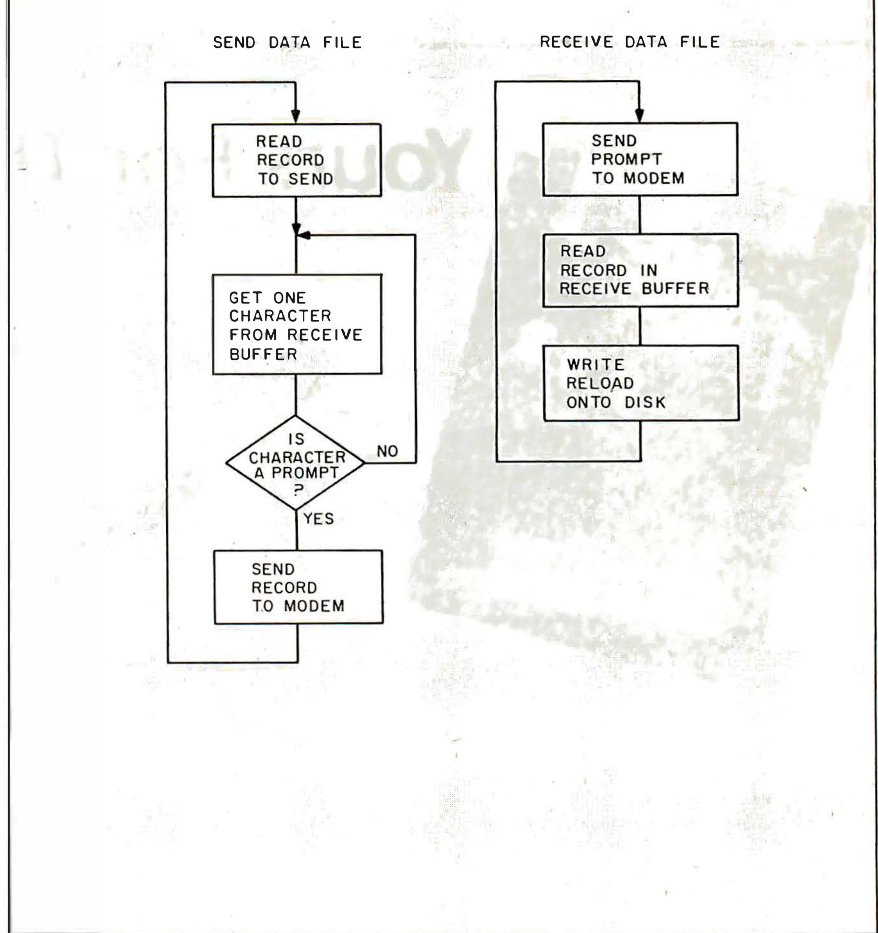


Figure 3: *Flowcharts detailing the logic for sending and receiving files, respectively. See listings 2 and 3.*

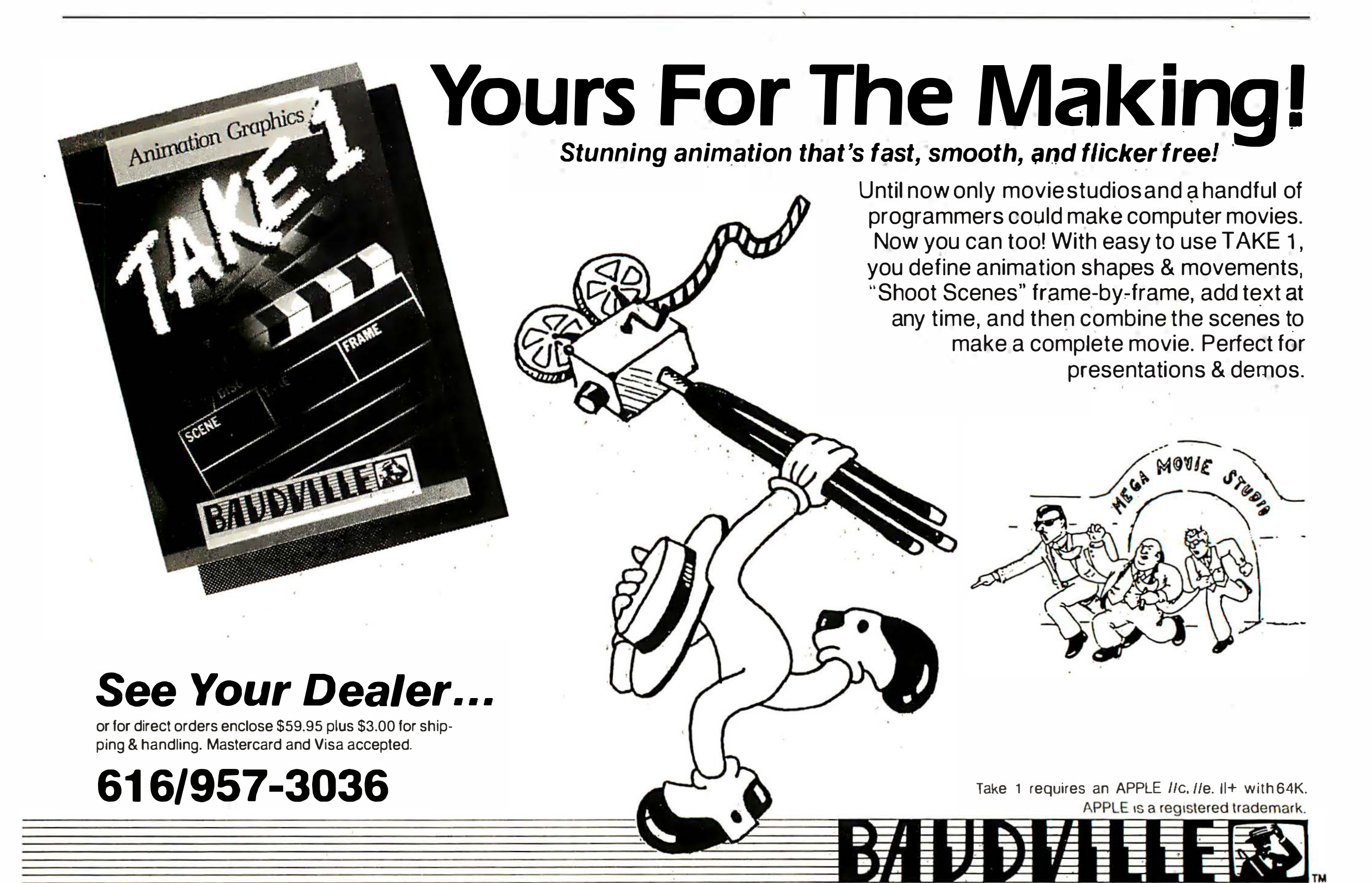
Listing 1: *The BASIC code needed to accomplish terminal emulation on an IBM PC. See figure 2 for the flowchart.*

```
10 ON ERROR GOTO 200
20 CLS
30 WAITING = 0
40 XON$ = CHR$(17)
50 XOFF$ = CHR$(19)
60 OPEN "com1:300,e,7" AS #1
70 B$ = INKEY$
80 IF B$<>"" THEN PRINT #1,B$;
90 IF EOF(1) THEN 70 : REM EOF(1) means receive buffer is empty
95 REM Check to see if receive buffer has more than 225 characters
100 IF LOC(1)>225 THEN WAITING = 1: PRINT #1,XOFF$;
110 A$ = INPUT$(LOC(1),#1)
115 REM Check incoming data for unwanted characters
120 FOR I = 1 TO LEN(A$)
130 D = ASC(MID$(A$,I,1))
140 IF (D = 17 OR D = 19 OR D = 127) THEN MID$(A$,I,1) = " "
150 NEXT I
160 PRINT A$;
170 IF LOC(1)>0 THEN 70
180 IF WAITING THEN WAITING = 0: PRINT #1,XON$;
190 GOTO 70
200 RESUME
```

The receiving program in turn sends a prompt to the sending program before it reads the incoming record from the receiving buffer. The particular prompt character used by these programs is a "?", although a better choice would be a control character, such as XON$ (ASCII 17). Why? In the unlikely possibility that a record consisting of a single question mark is transmitted through the modem in half-duplex mode, the sending program would mistake the character's echo as a prompt for the next record.

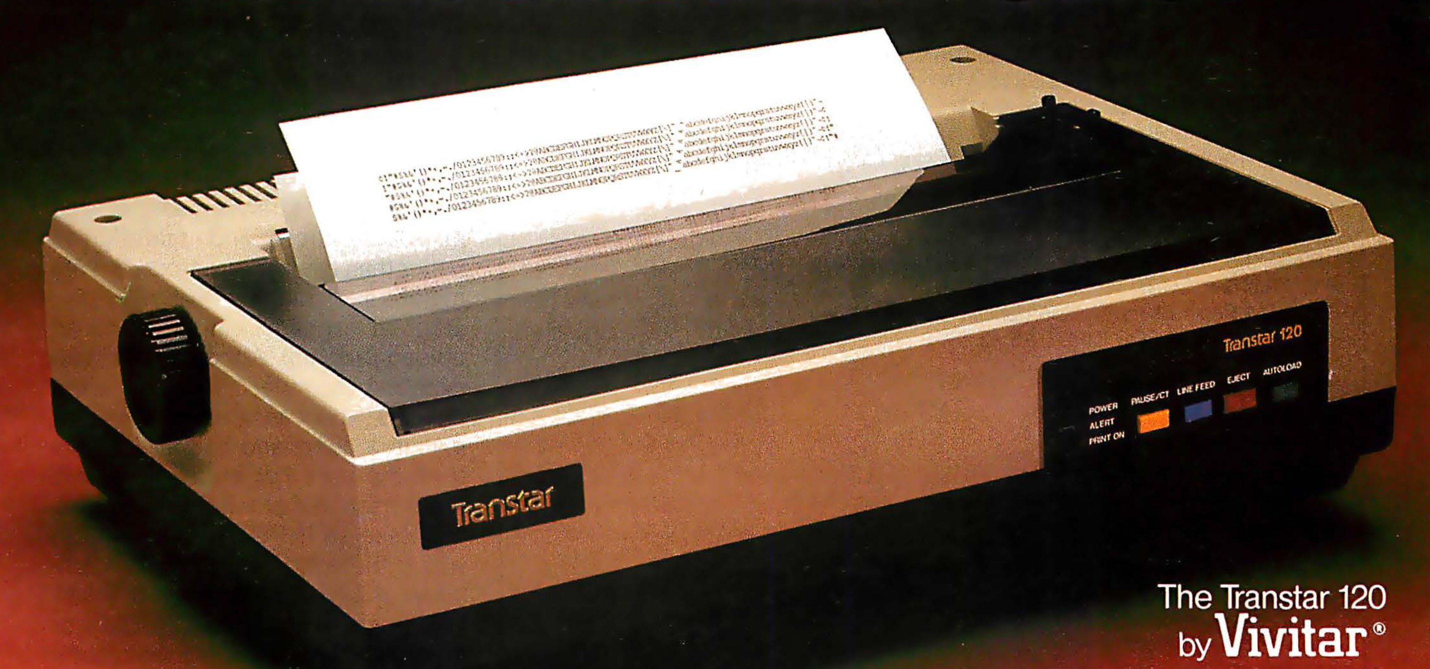
How do two programs actually begin the file-transfer process? In the examples in this article, the receiving program waits for the sending program to transmit the string RUN. The first piece of information sent is the name of the file the receiving program will use. After this "handshaking," the actual file transfer begins.

(continued)



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Listing 2: *The BASIC code required for an IBM PC to send a data file to the host or front-end computer. The applicable flowchart is shown in figure 3.*

```
10 ON ERROR GOTO 280
20 CLS
30 INPUT "TYPE FILENAME TO BE TRANSFERRED";NM1$
40 INPUT "TYPE NAME AT DESTINATION COMPUTER (IF DIFFERENT)";NM2$
50 IF NM2$ = " " THEN NM2$ = NM1$
60 OPEN "com1:300,e,7" AS #1
65 REM Transmit RUN command to receiving program
70 PRINT#1, "RUN"
80 A$ = INPUT$(1,#1)
90 IF A$< >"?" THEN 80
100 REM Transmit the name of the file to the receiving program
110 PRINT#1, CHR$(34);NM2$;CHR$(34)
120 REM Begin file-transmission phase
130 OPEN NM1$ FOR INPUT AS #2
140 IF EOF(2) THEN 220
150 LINE INPUT #2,A$
160 SUM = SUM + 1
170 V$ = INPUT$(1,#1)
180 IF V$< >"?" THEN 170
190 PRINT#1, A$
200 PRINT A$
210 GOTO 140
220 IF A$= "EOF" THEN SUM = SUM - 1 : GOTO 260
230 V$ = INPUT$(1,#1)
240 IF V$< >"?" THEN 230
250 PRINT #1, "EOF"
260 PRINT:PRINT "TRANSFER COMPLETE ..... NUMBER OF RECORDS SENT
    WAS "; SUM
270 END
280 RESUME
```

Listing 3: *The BASIC code necessary for an IBM PC to receive a data file from the host or front-end computer. The flowchart for this code is provided in figure 3.*

```
10 ON ERROR GOTO 220
20 OPEN "com1:300,e,7" AS #1
25 REM Wait for RUN command from sending program
30 PRINT "STANDING BY TO RECEIVE"
40 IF EOF(1) THEN 30
50 INPUT #1, A$
60 IF LEFT$(A$,3)< >"RUN" THEN 30
65 REM Get the name of the file from the sending program
70 PRINT #1, "?"
80 INPUT #1, NM$
90 PRINT "THE FILE WILL BE SAVED UNDER THE NAME ";NM$
100 PRINT : PRINT "WAITING FOR DATA TRANSFER TO BEGIN" :PRINT
105 REM Begin file-receiving phase
110 OPEN NM$ FOR OUTPUT AS #2
120 PRINT#1, "?"
130 LINE INPUT #1, A$
140 IF A$ = "EOF" THEN 190
150 SUM = SUM  + 1
160 PRINT A$
170 PRINT #2,A$
180 GOTO 120
190 CLOSE #2
200 PRINT:PRINT "THE NUMBER OF RECORDS RECEIVED WAS ";SUM
210 END
220 RESUME
```

You can command almost any system to wait for data from the user.

UPLOADING AND DOWNLOADING

In the case of uploading and downloading, the file transfers are between microcomputers and mainframes rather than two microcomputers. With minor modifications, the send program in listing 2 can work as an upload program. Although you must expect some variations with different systems, you can give virtually any system a command to wait for data from the user. For example, in CMS (Conversational Monitor System), you can issue an INPUT command from within the editor. In UNIX, the command is CAT > *filename*. In Super Wylbur, the command COLLECT has a similar effect. Once the mainframe is in this wait state, you can upload a file with the send program—without the handshaking but with the appropriate change in the prompt or turnaround character. At the completion of the upload, the terminal-emulation program lets you issue a command that takes the mainframe out of the "data-collection" state. Then the data can be saved or processed.

The receive program in listing 3 can, again with minor modifications, download files from a mainframe to a microcomputer. First, the download program issues a command (TYPE in CMS, CAT *filename* in UNIX, and LIST in Super Wylbur) to the mainframe to list the file to be downloaded. Then the program simply saves everything that the mainframe sends by reading the data in the receiving buffer and writing it to the disk. You might want to build blocks of data or records before you write the data to the disk in order to edit it before you copy it. (Similarly, you can easily filter or change records before you transmit them with the upload program.)

Extending the terminal-emulation program to transmit certain characters

(continued)

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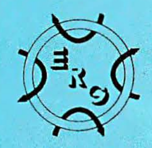
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GLOSSARY OF COMMUNICATIONS TERMS

ASYNCHRONOUS COMMUNICATION: each character transmitted is preceded by a special "start" bit and followed by one (or possibly two) "stop" bits; each time a character is pressed at the terminal keyboard, it is transmitted through the communications line.

DATA RATE: the rate at which signals can be transmitted.

FRONT-END PROCESSOR: a special communications computer linked directly to a host mainframe.

FULL-DUPLEX COMMUNICATION: the use of two different sets of frequencies by the originating and answering stations, enabling communications to take place in both directions at the same time.

FULL-DUPLEX MODEM: units that transmit a character without echoing it back to the sender; the echoing is done by the receiving station.

HALF-DUPLEX COMMUNICATION: enables communications in only one direction at a time.

HALF-DUPLEX MODEM: the modem echoes back every character it transmits; doubling of characters may be seen when both the modem and the receiving station echo back the characters.

HANDSHAKING: the establishment of the communications link.

HOST COMPUTER: the microcomputer or mainframe with which you want to communicate; the host is usually the controlling member of the communicating pair—you send to it, you receive from it, and you emulate a terminal connected to it.

LINE DISCIPLINE: the control of data movement across the communications line.

MODEM: a device necessary to convert the 1s and 0s of computers to different signals that can be transmitted over phone lines.

MODULATION: changing signals to distinguish between 1s and 0s.

PROTOCOL: agreed-upon rules and controls followed by the software to establish and maintain communications; protocol consists of handshaking and line discipline.

SYNCHRONOUS COMMUNICATION: an entire block of data (such as a full screen) is transmitted at one time; the data is usually preceded by several "synchronization" bytes and a special STX (start-of-text) byte and is usually followed by a special ETX (end-of-text) byte; fewer overhead or nondata bits are transmitted with synchronous than with asynchronous communications, so the line is used much more efficiently.

and to test for responses by the mainframe is also the basis for automatic log-on programs. Masking out account numbers and passwords and saving the programs in a protected form can also help provide a small measure of system security, which continues to be a major concern for individuals and corporations alike.

SUMMARY

Communications between microcomputers or between microcomputers and mainframes is a relatively simple project as long as you have a certain level of communications know-how. Listings 1, 2, and 3 provide short BASIC routines to accomplish terminal emulation, file sending, and file receiving, respectively. Understanding the terminology in various manuals can also be a great help. With the initial basics under your belt, you should be able to make that first stab at communications—"Watson, come here. I want you." ■





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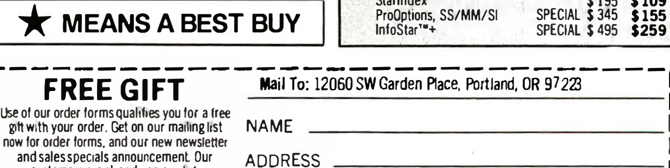
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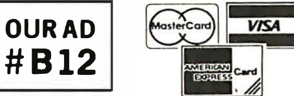
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LOOKING FOR THE PERFECT PROGRAM

BY DAVID BARR AND GEORGE DEW. ROGERS

Communications performance criteria

EVER HAD THIS NIGHTMARE? You badly need a survey of all the published spreadsheet software reviews. If you get it, you enhance your reputation at work by recommending the most powerful program on the market. You've decided to be courageous and phone the mainframe database, long distance, and pay the crippling hourly rate. It will cost you a few dollars, but it will be more than worth it if you get that next promotion.

Everything goes well for once. You boot up your terminal-emulation software, dial the 14-digit number, sign on, and the host computer actually recognizes the password they gave you when you phoned in your credit-card number the day before. The database seems relatively easy to search, as you feverishly enter the right keywords with one eye on the clock. The host pauses, and you visualize banks of giant hard disk-paks spinning with a chorus of high-pitched hums as read/write heads seek back and forth, picking out the information you want. Then the first titles begin to scroll by on your screen, obediently piling up in a RAM (random-access read/write memory) buffer so you can dump them to a disk file after the session.

But what's the matter with these titles? There's the odd one on spreadsheets, but nothing like you were expecting. Looks like you used the wrong keyword.

Well, no problem. At the start of the session, the host computer said you could abort any function by pressing the Break key. Break key? Your microcomputer certainly doesn't have one of those. You dash for your terminal-emulation software's instruction manual and thumb your way through it. Meanwhile, all that information you don't need is scrolling serenely off the top of your screen. Finally you find an obscure reference to Break. Supposedly, if you key in the sequence Escape Shift-7, your software will send out an ASCII (American Standard Code for Information Interchange) 127 character (7F hexadecimal), recognized as a Break by some systems. You try it but the host keeps spilling out information you don't need or want.

Now it's panic time. You've already been on the air 20 minutes, you've had a buffer overflow (you're not even capturing that garbage anymore), and those credit-card dollars are totalling up faster than the dials on the pump at the gas station. What to do?

You could just pull the plug. However, not only does that offend your sense of elegance, but you remember the sign-on warning that any improper sign-off could result in your being billed for a full hour or more of expensive mainframe time. Feeling doomed you sit bolt upright, bathed in a cold sweat. And then you wake up. It was all a dream. You didn't pour all that money down a dry hole. Yet the frustrations and unnecessary ex-

(continued)

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pense encountered with the wrong terminal-emulation program are real. Which one is for you? It's almost a full-time job deciding which features you want and which are just superfluous frills.

Features—What Do You Really Want/Need?

Maybe the best way for you to start is to decide just what you want your communications program to do. If, like us, you're interested in learning about your computer while using it, your wish list might go something like this. You want to communicate with a wide variety of host computers that answer their own phones. You want to use freely any functional programs available on those host systems. You must be able to send information from your disks or RAM. And you want to send information generated by a program running on your machine while you are connected to the host.

Additionally, your communications software must capture and save usable information sent from a computer at the other end of the phone line. You might want text, for example, ready for your favorite word processor.

Last, but not least, you will eventually want your modem-oriented software to send information between two serially hard-wired computers. It's this latter function that leads us to suggest you should really be thinking about communication, not just terminal emulation.

We've used everything from the earliest commercial microcomputers with their severely restricted memories to new lap-size portables, and high-powered jobs with hard disks and RAM disks. We have spent (or misspent) countless hours communicating with all kinds of hosts, and we've used dedicated, dumb terminals as well as microcomputers that were configured as both dumb and smart terminals. As a consequence, we've spent more time than we care to remember scratching our heads and wondering why nothing will work.

Along the way we've developed highly personal, and maybe slightly opinionated, views of what we'd like to see in the ideal communications program. So have a look at our wish list and tell us if there's any commercial program that can do everything we want. At the very least, our ideas may give you some guidelines as to what to seek as you select communications software.

Signing On

Unless you're wired directly to the object of your communicative affections, you're going to have to deal with "Ma Bell." There is a whole set of communications software features involved with getting connected to a host system and successfully logging on. But there are often other signals that the host requires for recognition, such as a specified number of carriage returns, control characters, or assorted punctuation marks. Remembering all of these, plus the telephone numbers to establish the connection in the first place, can be tedious at best. It is next to impossible if you skip around a lot and change your passwords regularly for improved security. Thus the macro command or "macro."

Most software manufacturers use their own names for macros, but, in general, they let you establish a disk file with telephone numbers and a whole sequence of stored commands (including pauses to wait for host response). Macro commands can be used to activate a modem with dialing capability and then automatically satisfy the expectations of the prospective host at a single keystroke. A macro may seem like a frill before you buy your first communications program, but if you do much telecommunicating, you'll soon come to look upon it as money well spent. Watch out, however, for the macro that permanently redefines some of your keys. It's disconcerting to type a message, only to find that every ? fires out your password.

Your microcomputer also has to match the type of data signals sent out with those expected by the host.

(continued)

The bottom line in data communications is getting information from one computer to another as quickly as possible without errors. In most cases, this operation consists of retrieving, organizing, appending to, and directing data. Since computers, for the most part, whir away autonomously upon our desks, any dialogue between two or more of them must be extremely regimented and specifically defined. Time and protocol are the critical factors.

Communication is a real-time event. Electronic signals or data, when transmitted, take a finite amount of time to travel from source to destination. In order for one computer to retrieve data sent by another, it has to know the duration of each data bit and the rate at which new bits arrive. Sharing this basic knowledge, the computers are assured of transferring data discretely and without fragmentation.

Working with the instructions from a communications program, the computer translates the data bits into meaningful information. The translation is governed by rules and standards with which both sending and receiving computers comply. These rules and standards define the protocol, which is the mechanism for packaging, routing, and unpackaging data.

That's all there is to it, really. Protocol tells the computer what the information is and what to do with it, and time tells it when it will be there. Provide a computer with those two elements and you give it the ability to communicate. Naturally, implementing a communications program with the abstract principles of time and protocol on the reality of chips and wires gets complicated, but keeping these two concepts in mind should make the complexity manageable and understandable.

Two Methods

Communication takes place with one of two basic temporal methods: asynchronous and synchronous. With the asynchronous method, the arrival and departure of data is timed by a general clock that sets a rate, called *baud*, that measures the speed of the data transmission in bits per second. The actual arrival and departure of ASCII (American Standard Code for In-

THE BARE NECESSITIES

BY LARRY FELSER

formation Interchange) characters is signalled by information appended to the raw data. With the synchronous method, data transmission is timed by the same baud clock but, in addition, the conversing computers share a common clock and thus are able to time character arrival and departure without each character having to carry such signals intrinsically.

Using the asynchronous method, each character sent down the communications line carries its own clock bits. The start bit tells the receiving computer that the eight bits of an ASCII character are coming in. The stop bit tells the receiving computer that the entire character has arrived. Before being sent out the communications port, each character must be supplied with a start bit at the front of its eight bits and a stop bit at the rear.

Although precise clock synchronization is not required with asynchronous transmissions, the sending and receiving computers must agree on a baud rate. All elements in the communications setup must be set to the same baud, including modems, computers, and software.

SYNCHRONOUS EXCHANGE

Data communication with the synchronous method is more time-restrictive but requires no appended data bits to indicate character arrival. In addition to the data transferred, two synchronously conversing computers share a consistently oscillating modulated signal, called the clock signal. Typically, in the micro world, this clock signal is supplied by the modems and transferred for the duration of the link in parallel with the data stream. The clock tells each computer when to sample the data, ensuring only whole bits are received. In the initiation of a synchronous transfer, the sending computer first sends one or more "sync" characters. The receiving computer uses these characters to "synchronize watches" with the sending computer. In this manner, the receiving computer knows when to expect the next character.

For example, computer A is in Maryland and computer B is in New Hampshire. B is going to send data to A synchronously. They first determine what baud to use; this, for the most part, is a function of the modems. They also have to determine what protocol to use, which we'll cover later. Once the baud and protocol have been set, B calls A. The first character B sends down the line is a sync character, which is simply an agreed-upon ASCII code or its EBCDIC (extended binary-coded-decimal interchange code) equivalent. Parallel to the data stream is the clock signal, which determines the data sampling rate. A will be looking for B's sync character and will not accept actual data until the sync arrives. Once A has received this character, it then knows at what time every other character of B's transmission will arrive, since B, in its data stream, will never leave the line idle. During points in the transmission when no data is sent, B will send "pad" characters; these pads are inserted to keep the line in sync at all times. This is the key to efficient synchronous transmission. Since B has first told A its character arrival sequence with the sync characters, and since A is assured that there will always be characters on the line, there is no need for each character to indicate its arrival.

This type of timing allows entire blocks of characters to be sent at once, which is very efficient. However, the protocol for size, start and end points, contents, and sequence of a block in a series of transmitted blocks must be defined. In addition, assurance must be given that the data transmission has been executed without error. With the synchronous method, organization, control, and assurance of data is the job of protocol.

PROTOCOLS

There are two main types of synchronous protocol: byte-synchronous and bit-synchronous. The distinction is that bit-oriented protocols recognize and interpret individual bits of the data stream, whereas byte-oriented protocols deal only in whole 8-bit characters. (SDLC/|Synchronous Data Link Control| SNA |Systems Network Architecture| is an example of bit-synchronous protocol.) Bit-synchronous communication deserves a book of its own and I won't attempt to cover it here.

Byte-synchronous or bisync protocols come in many varieties. They were first developed on mainframe computers, generally for connecting many separate terminals to the same CPU (central processing unit). The protocols are distinguished both by the type of terminals used and the task to be carried out. For example, the most common terminals, IBM's 3270 series, were designed to communicate interactively with the CPU. Most 3270 terminals communicate using bisynchronous 3270 protocol. Other devices transfer batch jobs to, and results from, a host CPU. Batch jobs are programs or data that are transferred to the mainframe computer all at once and queued up to be run by the CPU noninteractively with the user. For this type of task an entirely different protocol was developed. A very common member of this set of protocols is Bisynchronous 3780, again taking its name from a line of IBM terminals and peripheral devices.

ENTER MICROCOMPUTERS

Within the last few years, microcomputers have dropped in price to the point of being competitive with commonly used terminals. A natural progression in the modern office is toward giving individuals the power and flexibility of a personal computer as opposed to the shared resources of a single mainframe computer. Indeed, many offices that could never afford computing in the past can now purchase a complete computer system for a price comparable to that of a three-year-old Ford with bad tires.

As sensible an alternative as this may seem, many companies are reluctant to give up their mainframe processing, with its years of investment and the ability to tap into the often vast and omnipresent capabilities of host computers. The solution is to provide micros with the ability to emulate terminals and thus be able to converse with and utilize mainframe applications, while retaining the quality of being personal computers.

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This gets us into the rather technical world of baud rate, parity, and other aspects of data format. [See the text box "The Bare Necessities" by Larry Felser, on page 201, for an explanation of communications formats and protocol.]

The baud rate is a bandwidth-oriented indicator of the speed (in characters per second) that data is sent over the phone lines. (See "High-Speed Dial-Up Modems" by Kim Maxwell, page 179, for the difference between bit rate and baud rate.) The capability of your machine to communicate at different speeds depends on the characteristics not only of your modem but also of your communications software. Most host computers of our experience can still be accessed at 300 baud (approximately 30 characters per second). Increasingly, more can also communicate at 1200 baud. Becuase 1200-baud modems are becoming more widely available at a reasonable price, we predict it will increasingly become the standard in the future. Eventually you won't be able to access new systems unless you can transmit at the higher rate. You had better take a look at whether the program you are contemplating can switch baud rates, either automatically or manually.

The rest of the topic of communication format, namely data length, parity, and number of stop bits, is pressingly important. If you can't seem to make a new host listen, chances are your software is not sending data appropriately. Change one or more of the basic format variables and, as if by magic, the host will understand you. Obviously, the ideal communications program will allow you to set these variables independently (and without having to resort to machine-language programming).

Even better would be a microcomputer communications program that would detect the host's data format and tell you if you have to change your format. Best of all, the program would perform the change automatically, perhaps just informing you of what has happened for future reference.

Using the Host

After you're logged on and the host is responding nicely to your queries for information, your next major concern is to have the complete freedom of the host's software. Depending on your host system's sophistication, this software may range from a simple set of menus to word processors, spreadsheets, adventure games, or compilers for languages like Pascal, C, and APL. The rub is, the more diverse your desired host programs, the greater your need to send special signals. Such signals can range to some of the more exotic extras in the

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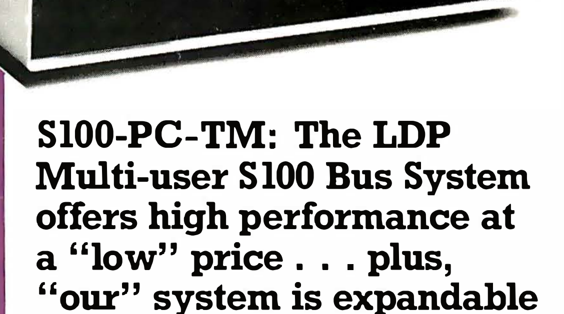
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cast of 128 ASCII characters. In extreme cases, a full range of 256 different characters or character signals may be necessary. Chances are, your microcomputer doesn't supply all of these from the keyboard. If it doesn't, your software had better do it for you. The best communications programs let you create a wide range of data signals from your keyboard. Be warned. You may have to memorize an extensive set of multiple keypresses.

Perhaps the most frustrating special signal is the physical break. Some communications software talks about a Break code. It turns out, however, that they are only talking about a Control-C (often used to terminate a program in operation). If your host requires a physical break, Control-C (or any of the ASCII characters you try to send) will have no effect whatsoever. What is needed is a momentary cessation in the carrier signal. This means your software must have control over the electronics of your modem. That short break in the carrier is detected by the host and interpreted as a command to interrupt program execution.

The best communications programs will let you alter the length of the break. This is crucial. Too short an interruption will not be noticed by the host. Too long an interruption may cause it to hang up on you, on the assumption that telephone contact has been lost. You probably have already guessed that hosts that require a Break signal differ in their requirements for the ideal length of the break.

Downloading—Becoming the Perfect Parasite

All communications software will let you perform the functions we've talked about so far. That is, to qualify as communications software, a program must let you contact and log onto a remote host system and let you use the host's programs. A program that does only this lets your micro emulate a "dumb" terminal.

The first additional feature a "smart" terminal-emulation program usually provides is "downloading." Downloading means that your micro can capture and store, temporarily or permanently, whatever is sent to it by the host.

The simplest and most widely used form of downloading is reserving some RAM as a buffer. Then you store all incoming characters in the buffer as they are shown on the screen. Later the contents of the download buffer are stored on a disk where they are accessible to utility programs for further reference and manipulation. Accessible, that is, if stored as a simple text file under your operating system.

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Of course, if the reserved RAM area gets filled up, recording generally ceases. The rest of the information is lost. Even if your micro automatically saved the contents of a full buffer to disk, the time it took for that would lose information. The upshot is that the download buffer should be as large as possible, at least 30K bytes to store about 15 pages during a single downloading session. Since the download buffer memory will be larger the smaller your communications program (CP), another mark of a good CP is that it occupies a minimum amount of RAM.

One way to retain information during downloading is to set up a system of prearranged stop and start signals between the receiving micro and the host. Sometimes such a system is known as "handshaking" because the two computers cooperate during data transfer. The result is that information is sent by the host in blocks, because after the microcomputer has had enough, it signals the host to stop sending until the data already sent has been stored to disk. Then the micro sends the go-ahead signal and the host sends until it receives the next stop signal. Unfortunately, different hosts recognize different stop/start signals. So your CP should have the option of choosing several different variations on this pattern.

There's an additional wrinkle to altering protocol. A few programs let you pause after you make the telephone connection and change your protocol in midstream. Those that don't can make your life difficult by making you lose data.

A different method of combatting the problem of potential data loss during downloading also provides a solution to garbled data due to telephone-line noise. Noise is the presence of random electrical signals (you can even hear some of them as clicks or static) in the telephone company's transmission lines. Depending on how much is present, your data may be almost unreadable after transmission. Fortunately, some commercial communications software packages (and some in the public domain, too) incorporate an error-checking method of data transfer that allows only good (i.e., unaltered) data to be captured.

For these error-checking communications programs (Christensen, or XMODEM, and Kermit are two popular examples), both the host and the receiving micro have to use the same convention. Data is sent in bursts of 128 or 256 characters by the host. At the same time, the sum of the bytes in the packet is sent along with the

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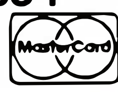
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packet. The program in the receiving micro captures the data and also sums the packet's bytes. Only if the micro-generated sum is the same as that sent by the host is the data accepted. If it differs, the program assumes that an error has occurred, i.e., that line noise has altered the data in some way. That packet is then discarded, and the host sends the last set of characters again.

Notice that with error-checking protocol, the host sends only one packet of information at a time. It never sends more until you tell it to do so. This means that only a small download buffer is needed. The communications software pauses and dumps the buffer onto a disk before advising the host that it is ready for the next packet. Downloading by one of these error-checking methods is more accurate than using a simple download buffer. The process can go on all day without losing information, and watching two machines perform flawlessly in tandem is a kind of high-tech poetry. But remember, whenever time is at a premium, error-checking transmission is much slower than simple downloading, and it can get very slow indeed if there is much noise on the line.

A software filter is another of those things that may seem like a luxury but isn't. When downloading information to a remote microcomputer, different hosts will mix in a variety of special characters (often control characters) with the transmission. Most frequently found are the carriage return (Control-M) and the linefeed (Control-J). Depending on your final use for the data, these special characters can be annoying. Furthermore, unwanted control characters can cause functional changes in your microcomputer if they correspond to codes used by your software. The only solution to this kind of problem is to have the communications software filter the incoming transmission. It must either discard certain characters you don't want or replace them with acceptable alternatives. Filtering is often accomplished by a translation table. Such a table allows you to specify beforehand exactly how each incoming character is treated and changed before it is stored.

One common downloading feature that doesn't seem too important to us is the ability to turn on the printer and transmit characters to it during the course of direct downloading from the host. This, of course, gets around the problem of lost information, but it can slow you down so much that it hardly seems worth the trouble. Besides, once you use paper you can't erase it like a disk file. You run the risk of wasting a lot of paper on useless information. And if you now believe that unwanted control characters can screw up a disk file, you should see what they can do to a printer. There, control codes are routinely used to set such functions as paper advance, font size, etc. As a general rule, it's probably most efficient to download directly to a disk file and print anything that looks interesting at a later time.

The only real use we've found for the printer while we're communicating is to record the menus of a new host system. When logging on for the first time, it is convenient to print out the menus and sign-on messages immediately so you can continue to explore the system. Otherwise, you may waste a lot of time re-calling those menus for reference. You can't afford too much delay while you try to remember what to do next. Many host systems are set up with "timed out" capabilities. In other words, if you haven't sent a command by the time the host thinks you should, the system will automatically log you off and disconnect.

Uploading—I Can't Believe It Ate the Whole Thing

The other side of "intelligent" terminal operation is sending stored files from your microcomputer to a host computer—what's known to the cognoscenti as "uploading."

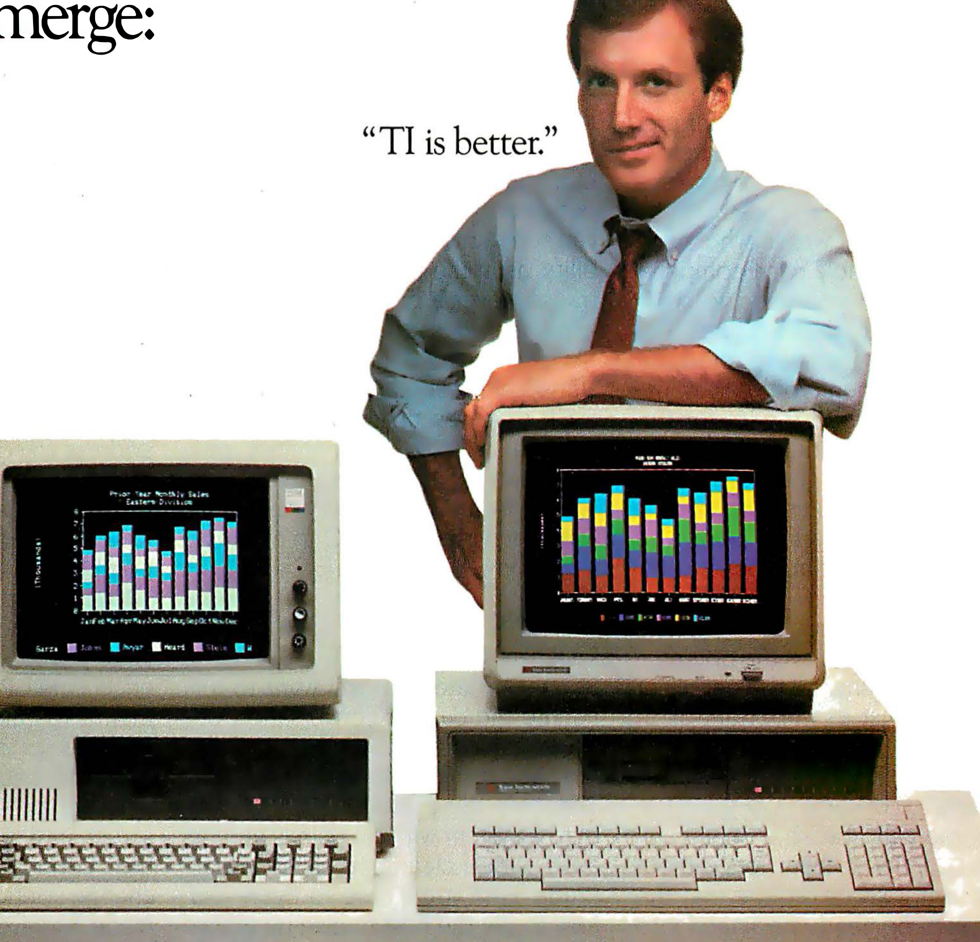
Why would anyone want to upload? The reasons differ widely and are pretty specific to the individual. Perhaps the most common reason is

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The only thing trickier than getting onto a system without pain is getting away with a clean and satisfying attitude.

that the host computer is being used for electronic mail (EMAIL)—sending a message to be read by another user of the system. Often the EMAIL editor programs are rather primitive. You may prefer to use the word-processing software on your microcomputer to prepare and edit messages before sending them to the host for processing.

Maybe you're a writer who composes with a portable microcomputer on the road and you need to store text files for your magnum opus. You send them to a mainframe host for safekeeping. When you get home again, you download the lot for further editing and printing. Maybe you use your micro as a "glass keypunch." Programs and data files prepared on your own system are later sent to a mainframe to run big number-crunching jobs.

Whatever your reason for uploading files to a host computer, the potential problems are many. All the details of protocol are just as important as in downloading. In addition, there is wide variation in the ability of host computers to consume your transmission. Some can absorb a seemingly endless quantity of characters without a complaint. Others require that the data stream be neatly packaged into individual lines, separated by carriage returns, sometimes accompanied by linefeeds.

If you are to use these varied systems automatically, your CP must not only be able to read a disk file and send it out over your modem, but must also be able to send it in the fashion required by the host. If it can't, the result will be error messages, confusion, and usually a breakdown in communications with the attendant waste of time, and maybe money, too.

Machine Access—Stop the World, I Want to Get Off

When you're telecommunicating with another computer, you might still want complete access to your own machine. (Most CPs don't allow this.) At the very least, you are sure to want to check your file list (and also to change data disks during the session). Maybe you'll need to review a disk file before uploading or after downloading. It should be fairly easy to find those capabilities, but some programs don't allow them.

It's still harder to find a CP that will let you run one of your own programs while you're connected to the host, so that you can send your program output directly over the phone line. This can sometimes be a very useful capability, as in the job one of us had, to transfer over a thousand sequentially numbered, short disk files over the phone line to a minicomputer for statistical processing. We didn't have a CP that was up to doing the job automatically, so the primitive programmability built into the modem had to be utilized. A jury-rigged CP was improvised in BASIC, to minimize the agony.

Signing Off—Say Goodnight, Gracie

Sooner or later you will want to terminate the current conversation between your microcomputer and the host and move on to something else. The only thing trickier than getting onto a system without pain is getting away with a clean and satisfying attitude. First you'll have to figure out how to get the host to give up gracefully. It seems they all have different requirements for saying good-bye.

If you have a direct-connect modem, you'll also want your CP to be smart enough to tell it how to hang up the phone. Some communications software is tailored only to work with specific communications hardware—fine and convenient if you happen to have all the parts that work together. We think it's a little better to have the flexibility to define macros so that new hang-up commands can be sent to a new modem when you need it. Of course, you can always just "pull the plug." But that's so inelegant (to say nothing of kludgy), you run the risk of endangering your health through sheer mortification.

General Features

In addition to the necessary functions mentioned above, there are a host of other factors to take into account. Some, while not crucial, are vexatious to do without. We know of one package, for instance, which, in its first commercially available version, didn't allow files to be read from or written to any disk drive other than the one from which the program disk had been booted. That program disk had to be removed from the drive before any intelligent terminal operation was possible—a constant source of annoyance. Fortunately, the second version of the program had the necessary option to redirect input and output from/to a second disk. Ideally you should look for a program that can address any of several disk drives you may have now or might add in the future. (This will be especially important if you add a hard disk at some point.)

Not all special features are so critical, and some may be regarded as largely a matter of personal preference. One CP has an extensive set of menus to guide you through such intricacies as selecting block-transfer protocol, baud rate, and disk drives. Another presents you with a blank screen and relies on memorization of the control codes necessary to change options. Changes can be made, however, without first switching to a special menu.

The first program is easier to use for the first month or two. In addition to being hand-held through the necessary steps, it is always clear which on-screen messages are coming from the host and which are coming from the communications software. For the experienced user, however, the second program is preferable. It isn't

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necessary to call up an annoying series of menus to initiate each simple operation.

Clearly, which kind of program you look for depends a lot on your personal preference. We think the ideal solution is a program with extensive menu guidance for the uninitiated, but with the option to skip all menus for the experienced user.

Another feature you might not think you need until you have wasted 40 minutes and 1000 keystrokes is the ability to automatically redial a number and sound a warning that connection with that busy host system has finally been made. Anyone who frequently has to use telecommunications will quickly place this in the "must have" category. You'll be able to continue other activities, secure in the knowledge that a clear and recognizable signal will be sounded when the link is ready.

Finally, some CPs come with a batch of utility programs that may be run before or after the on-line session with the host. These are usually related to processing disk files so they can be transmitted more easily, or interpreted or printed readily after downloading. It is possible, for instance, to translate a binary file into ASCII form for transmission with a utility program. But wouldn't it be better to simply build the facility for transmitting binary files into the CP in the first place? The same might be said of utilities that allow transfer of disk files between each of several operating systems you may run.

Generally, the question of special-purpose utilities accompanying the CP seems to us a minor one. The most important utilities should obviously be built into the program. The less important ones are better handled by a utility like a word processor.

At this point, perhaps the last and most useful guideline we can suggest is to remember that like almost every other product that is subject to technical and design limitations, the "best" CP is going to mean different things to different people. Since the more features you have, the more memory you use up (or the more time-wasting disk access you require), you can't have everything in a single program. Judging communications software should be a matter of evaluating the trade-offs. In other words, excellence becomes a matter of how many features the author of the package was able to include without sacrificing compactness and efficiency.

Whatever you are looking for in CPs, you're sure to find a considerable variety to choose from. And when at last you find the program that does almost everything you want, we can guarantee that you're in for a fascinating experience in telecommunication. ■

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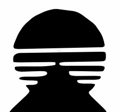
BetterBASIC is ____.

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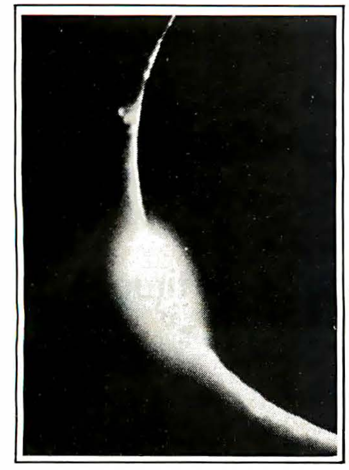
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Object Code Size (bytes)	128	255	329	181	415
Program Load Time (secs.)	3.2	3.8	6.3	11.2	23.5
Compile Time (secs.)	8.5	—	—	3.9	108

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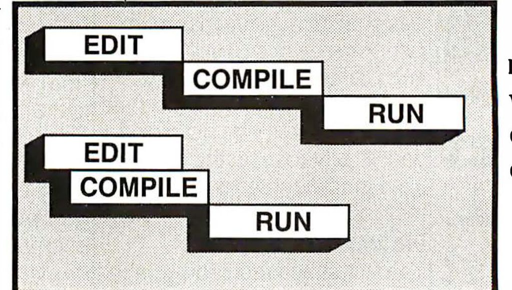
It also speeds input by reducing manual typing as much as 90%, letting you enter statements with a single keystroke. For example, if you type a capital "I" at the beginning of a line, the editor completes the logical "IF THEN" statement automatically, so you can concentrate on what you want to program, rather than your typing.

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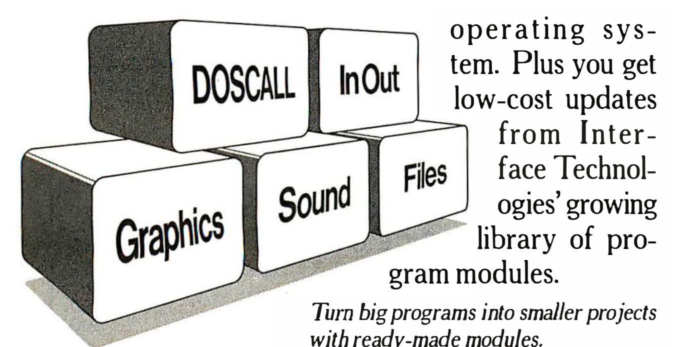


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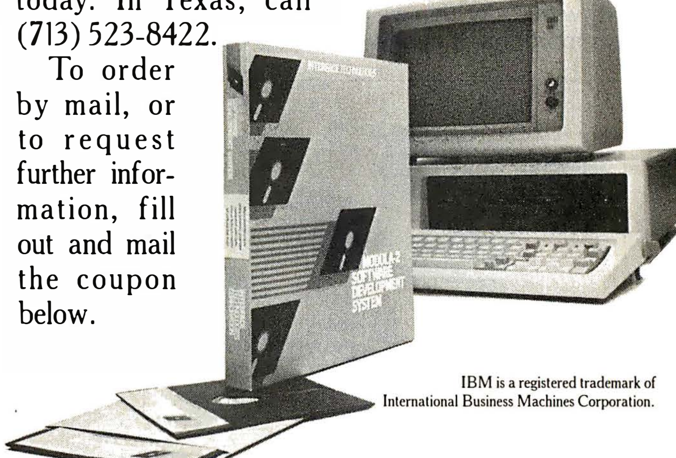
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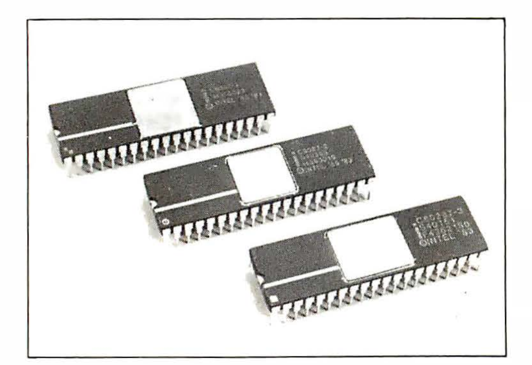
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THE ON-LINE SEARCH

BY SUZANA LISANTI

Accessing the world's electronic brain

UNTIL RECENTLY, only librarians and specialists with extensive training and a prime-time, prime-rate budget found searching for information from the world's "data banks" an easy task. Now, anyone with a terminal, a modem, and a password can access any of 344 of these data repositories, offering over 2400 database files—with a minimal amount of fuss.

Pricing policies for access to, and use of, these on-line services vary greatly. About 35 percent of the databases require some type of subscription payment, ranging from a $35 sign-up fee to several thousand dollars per year. However, the cost of on-line searches has begun to come down.

The following three developments have helped to lower costs. First, some information services have introduced low-cost subscriptions to their most popular databases, offering evening and weekend access. Dialog's "Knowledge Index" currently makes 24 databases available, and BRS's "After Dark" service provides access to 36 databases. A typical search on these services can be done for $5 or less. Other reduced-rate services offer a group of subject-specific databases (for instance, in business or medicine) to professionals for a flat fee, like $100 per month, allowing unlimited prime-time access.

Second, new *front-end* search software packages for microcomputers, such as In-Search, Sci-Mate, Search Helper, and Search Master, let you enter your search terms off line. By striking a single key, you are connected to a major on-line service. The software then performs your search automatically, downloads the results, and logs off. This can provide you with an easier interface to the database services, increase your productivity on line, and reduce your connect charges.

Third, new *gateway systems* are being offered by companies to get you into the database services. EasyNet offers a toll-free number you can call using your terminal, and upon approval of your credit-card number, you can use EasyNet's menu-driven system to search the Dialog databases. Neither a subscription to Dialog nor previous searching experience are necessary to use the system effectively. A typical EasyNet search costs $10 for 10 references.

The reduced rate services and new search software packages are revolutionizing the way we access information. Data banks are now available to everyone. Every home with a student, or a professional with continuing educational activity, has a potential on-line searcher. Every office where decisions must be made based on technical, legal, industrial, or market factors, or where parallels can be drawn with other cases, cannot afford to ignore the information available on line.

USER SEARCH SERVICES

BRS/After Dark and Dialog's Knowledge Index both became available for the first time in 1983. They offer non-prime-time service at reduced rates and give you a simplified way to search a select group of databases. With both After Dark and Knowledge Index, no previous training is required.

When you first log on to BRS/After Dark, you are given a choice of subject libraries. After a library is

(continued)

Suzana Lisanti is president of Lisanti Associates, an information and research company. She can be reached at POB 105, *Irvington,* NY 10533.

selected, the system responds by giving you a list of available databases within that library. You can then either read a description of each database or begin your search immediately. Either way, you proceed by choosing menu screens and replying to the prompts. The number of BRS/After Dark databases has increased fourfold in the past two years, and new databases are added every month. As of last October, there were 42 databases: 16 in sciences and medicine, 5 in business, 6 in reference, 7 in education, and 8 in the social sciences and humanities.

Most search features used in the prime-time BRS system also are available in After Dark. These include the AND, OR, NOT operators, truncations, specification of fields such as author, title, publication year, and descriptor terms. Once you become familiar with the menu-prompted searching, you can stack commands to bypass many menu screens, descriptions, and prompts. Prices for After Dark range from $6 to $20 an hour, depending on the database. You can run a complete search and print 40 references on line for about $5.

BRS is also developing a self-service option for libraries based on a plastic charge card that the patrons will sign out at the desk, as though it were a book. Possession of the card allows the user to activate the library's microcomputer and perform a search, within preset financial limits.

Dialog's Knowledge Index offers 24 databases divided into seven subject areas: Agriculture; Computers/Electronics and Engineering; News; Business Information; Magazines and Books; Medicine and Psychology, Legal; and Education and Government Publications. The amount of information offered on Knowledge Index increases regularly, with new files introduced quarterly.

Knowledge Index is command-driven, rather than menu-driven and, as such, allows for a more complex search strategy than After Dark. The documentation provided with a subscription is very good, and there are on-line help functions for each command. Most commands can be used in their abbreviated one-letter form. Documents can be ordered on line for an average of $8-$10 per article. (See table 1 for a comparison of Knowledge Index and After Dark.)

Table 1: *Both After Dark and Knowledge Index are reduced-rate services that require no previous experience or professional help to operate. Since Knowledge Index is command-driven instead of menu-driven, it lets you create a more complex search strategy.*

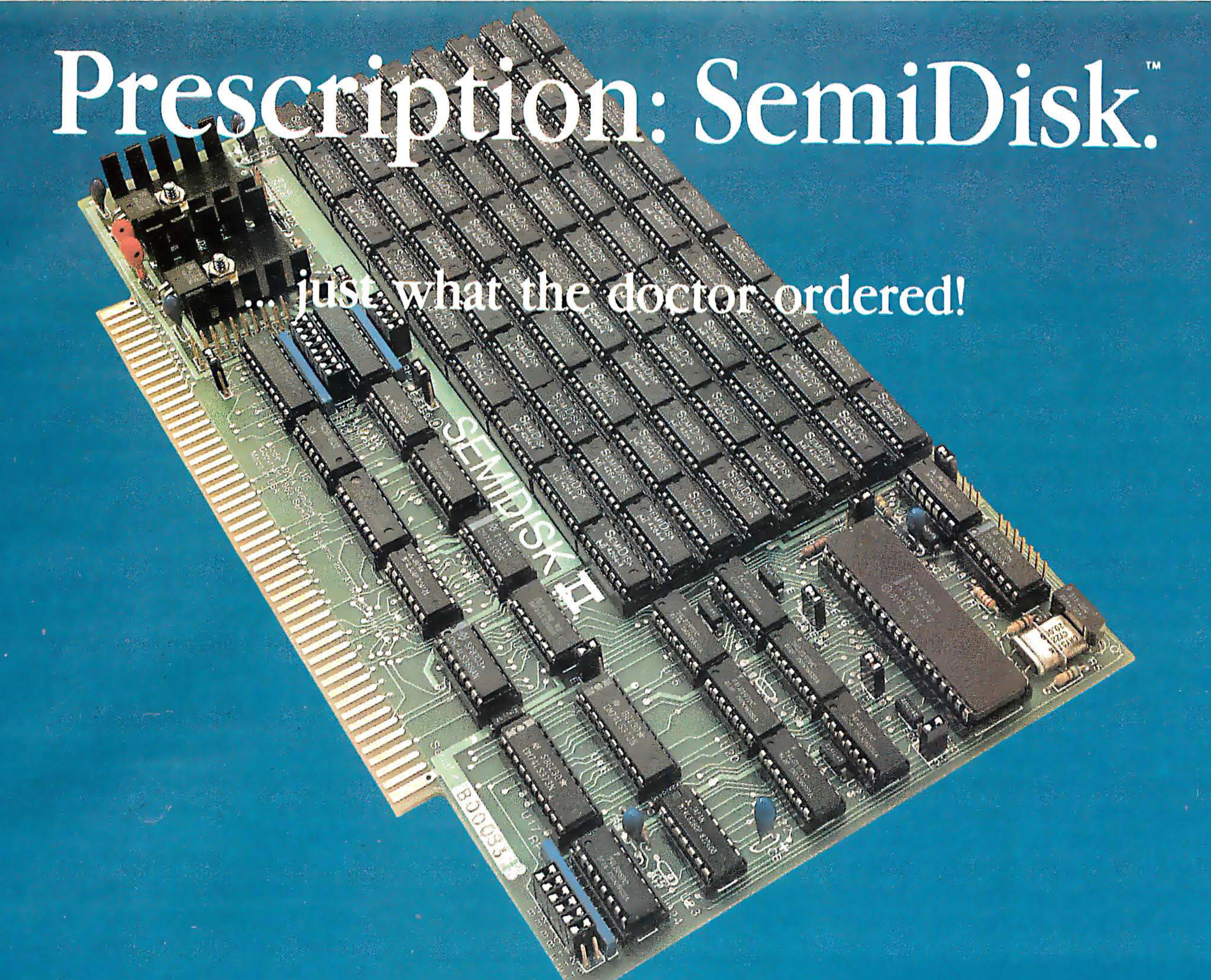
	After Dark	Knowledge Index
Type of system	Menu-driven	Command-driven
Hours available (beginning hour = local time; closing hour = E.S.T.)	Mon–Fri: 6 P.M.–4 A.M. Fri: 6 P.M.–midnight Sat: 6 A.M.–4 A.M. Sun: 6 A.M.–4 A.M., 7 P.M.–4 A.M.	Mon–Thur: 6 P.M.–5 A.M. Sat: 8 A.M.–midnight Sun: 3 P.M.–5 A.M.
Toll-free help line hours (E.S.T.)	Mon–Fri: 6 P.M.–1 A.M. Sat: 8 A.M.–5 P.M. Sun: 8 A.M.–2 P.M.	Daily: 7 P.M.–11 P.M.
Number of databases on line	36	24
Start-up fee	$75	$35 (first two hours free)
Connect prices per database	$6–$20	$24
Monthly minimum usage	2 hours	None
Search features:		
Boolean operators	AND, OR, NOT	AND, OR, NOT
Free text searching	Yes	Yes
Descriptor searching	Yes	Yes
Truncation	Yes	Yes
Limit by AU, TI, PY	Yes	Yes
Display COST on line	No	Yes
Help commands	No (menu-driven)	Yes
Print formats	S,M,L	S,M,L
Order documents on line	No	Yes
Electronic mail service	Yes (MCI)	No
Contact	BRS-Bibliographic Retrieval Services 1200 Route 7 Latham, NY 12110 (800) 553-5566 (518) 783-1161	Dialog Information Services 3460 Hillview Ave. Palo Alto, CA 94304 (800) 227-5510 (415) 858-3996

MICROCOMPUTER FRONT-END SOFTWARE

Front-end search software packages let you prepare and input your search strategy in advance. Then they automatically log on to the database service, perform the search, download the results, and log off. These packages offer simplified search protocols and, in some cases, help you choose the database you want to search. Because the actual search is done automatical-

(continued)

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If you've been "patient" with slow disk drives for too long, SemiDisk will relieve your suffering.

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ly, you spend both less time and less money with the on-line service.

IN-SEARCH

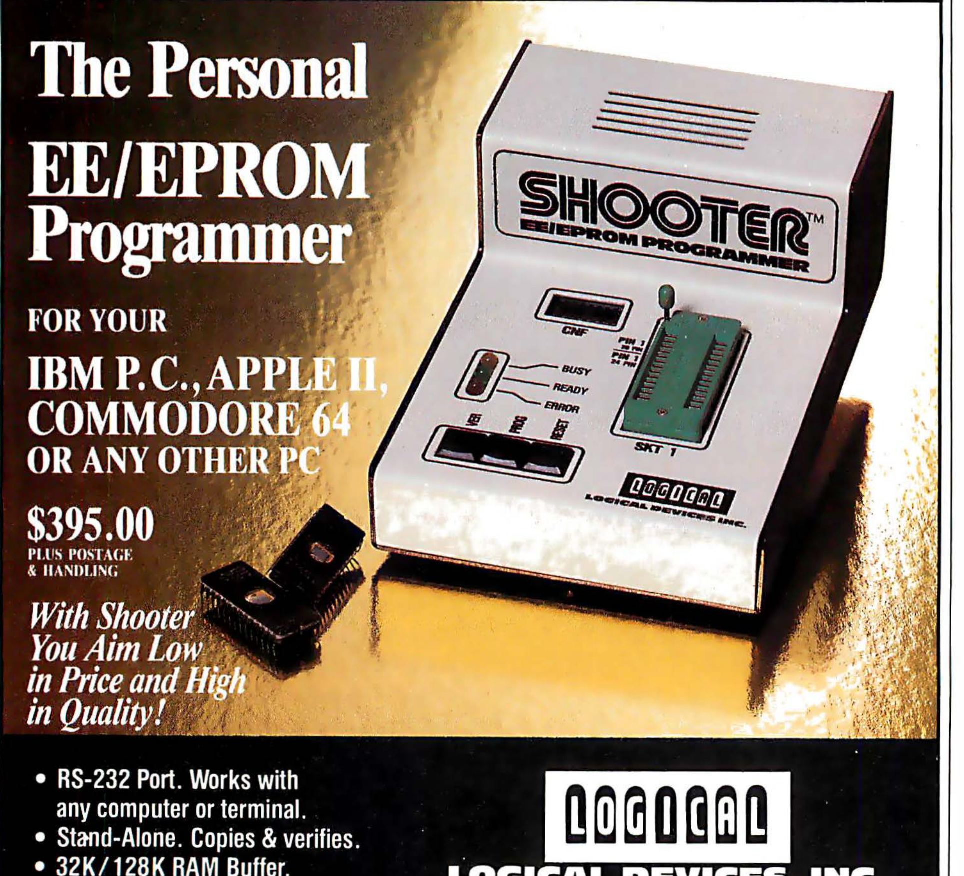
The In-Search search software package, from Menlo Corporation, is a front-end package that facilitates searching the Dialog databases and uses windows to create the illusion of library catalog cards. You can browse through these "cards" until you find a database you want to search. With In-Search, you first choose one of four main categories. You use the cursor-movement keys to place the cursor bar over the appropriate category in the screen's upper left-hand window: 1) Arts, Education, and Social Sciences; 2) Biology and Medicine; 3) Business, Government, and News; and 4) Engineering, Mathematics, and Physical Sciences. The next choice will indicate the possible 30-40 subject terms within each category displayed in the second window. These subject terms may be topical, such as electronics, or refer to the form of the source document, such as dissertations or conferences. You can then examine the system-selected database descriptions on center screen, like browsing through library catalog cards, to choose the database you want to search. At any point, you can move from the selection level you're on back to an earlier one, change categories, and browse freely. If you want more information on any specific database, you can call up the disks' data sheets and get further file descriptions, subject coverage, information on how the database is organized and indexed, the source documents, the address of the database producer, the name of a contact person, and his or her telephone number, among other items. This is the equivalent of Dialog's "blue sheets," the hard-copy reference source used by professional searchers. Menlo Corporation says it updates the database information on the In-Search disks once a month and ships the disks out to customers for free. They say they will make their updates on line in the near future, allowing users to download directly to Dialog.

After you select the appropriate database, you enter search words and phrases off line, to be processed by In-Search and Dialog automatically, once you are logged on to the system. The great advantage of any system that will let you input your search parameters off line is that you can edit those parameters without incurring on-line costs. Search lines may contain a single keyword (ARTIFICIAL), a phrase (ARTIFICIAL INTELLIGENCE), or an expression (s1 and s2) that makes use of Boolean operators and refers to previously entered set numbers. In-Search will automatically insert the adjacency operator W between words on a search line.

You can do more refined searches by specifying the field in which you want the search to take place. Before connecting to Dialog, for instance in the middle of inputting your search parameters, you can select the Index command and a window will appear with the list of the indexed fields for the specific database you have chosen. The author, title of article or book, and journal name are usually indexed fields.

When you are ready to search, a single function key will cause In-Search to dial up and log you on to the host system. The search is automatically performed. In-Search will let you edit a search line while on line. The retrieved data can either be stored on disk or sent to a printer. You might want to review the records in short format while on line, mark the records electronically with In-Search, and then retrieve only the marked records (which In-Search keeps track of for you) in medium or long format. To log off, press the Return key and In-Search provides Dialog with the appropriate disconnect protocols.

At any point during this entire pro-



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cess, the Help key will get you assistance. On top of that, I've always found the user's manual to be very clear on the basics of search strategies and in explaining the software. The search strategy can be saved, edited further, and reloaded in another search session.

In-Search runs on the IBM Personal Computer (PC) and compatibles that use MS-DOS 2.0 or later revisions, and the Texas Instruments Professional Computer. It requires a minimum of 192K bytes of memory and costs $399. For more information, contact Menlo Corporation at 4633 Old Ironsides, Suite 400, Santa Clara, CA 95050, (408) 986-0200.

SCI-MATE

Sci-Mate, from the Institute for Scientific Information (ISI), the producers of SCISEARCH and SOCIAL SCISEARCH databases, is a menu-driven microcomputer software package composed of two integrated systems: the Universal Online Searcher and the Personal Data Manager. Whereas In-Search assumes that novices will be its users, Sci-Mate's target is the science and technology researcher or information specialist, who will need to perform cross-system searches. The Universal Online Searcher lets you query major on-line systems using Sci-Mate's own "universal" menu-driven language that translates the search query to the various protocols appropriate to ISI's own databases, Dialog, BRS, NLM (National Library of Medicine), and SDC. Alternately, you can search any other database with the Universal Online Searcher through the database system's native index.

The Sci-Mate Universal Online Searcher will let you preformulate your strategy before going on line, and it will automatically dial up a remote system, perform log-on protocols, and perform your search, saving you on-line connect costs. Sci-Mate supports Boolean operators and it also lets you limit your search to specific fields and the browsing or scanning of the database index(es) while on line. When you are browsing, you can create search statements, and Sci-Mate will set aside groups of records containing the words you selected.

The companion package from ISI, the Personal Data Manager, is an off-line enhanced database-management system that lets you manipulate the downloaded data, reformat it for bibliographies and reports, add your own library references, search the records, and flag articles that have been ordered or are part of your collection. Though they were designed to be used together, both packages also work independently.

Sci-Mate runs on the IBM PC; Vector 3 or 4; Apple II, II+, and IIe; TRS-80 Model II or 12, and Kaypro 2 or 10. It requires a minimum of 64K bytes of memory. The Sci-Mate Universal Online Searcher lists for $440, and the Personal Data Manager for $540. The combined price for both is $880. For more information contact ISI at 3501 Market St., University City Science Center, Philadelphia, PA 19104, (800) 523-4092.

SEARCH HELPER

Search Helper, from Information Access Company (IAC), a division of Ziff-Davis Publishing Company, is a "novice-friendly" communications software package for accessing six of the IAC databases available through Dialog: Magazine Index, National Newspaper Index, Trade and Industry Index, Legal Resources Index, Newsearch, and Management Contents. This microcomputer system consists of software and a search contract to use the IAC files at a guaranteed cost of $2.50 per search (with a maximum number of 20 on-line prints). The system is primarily designed for inexperienced end users who would like to perform on-line searches by themselves at low cost. The target market for Search Helper is public, academic, and special libraries willing to pay $1750 a year for 700 searches and, in turn, offer these low-cost fixed-rate searches to their patrons.

Search Helper is fully menu-driven. You first select the database you want (a help screen describes the contents

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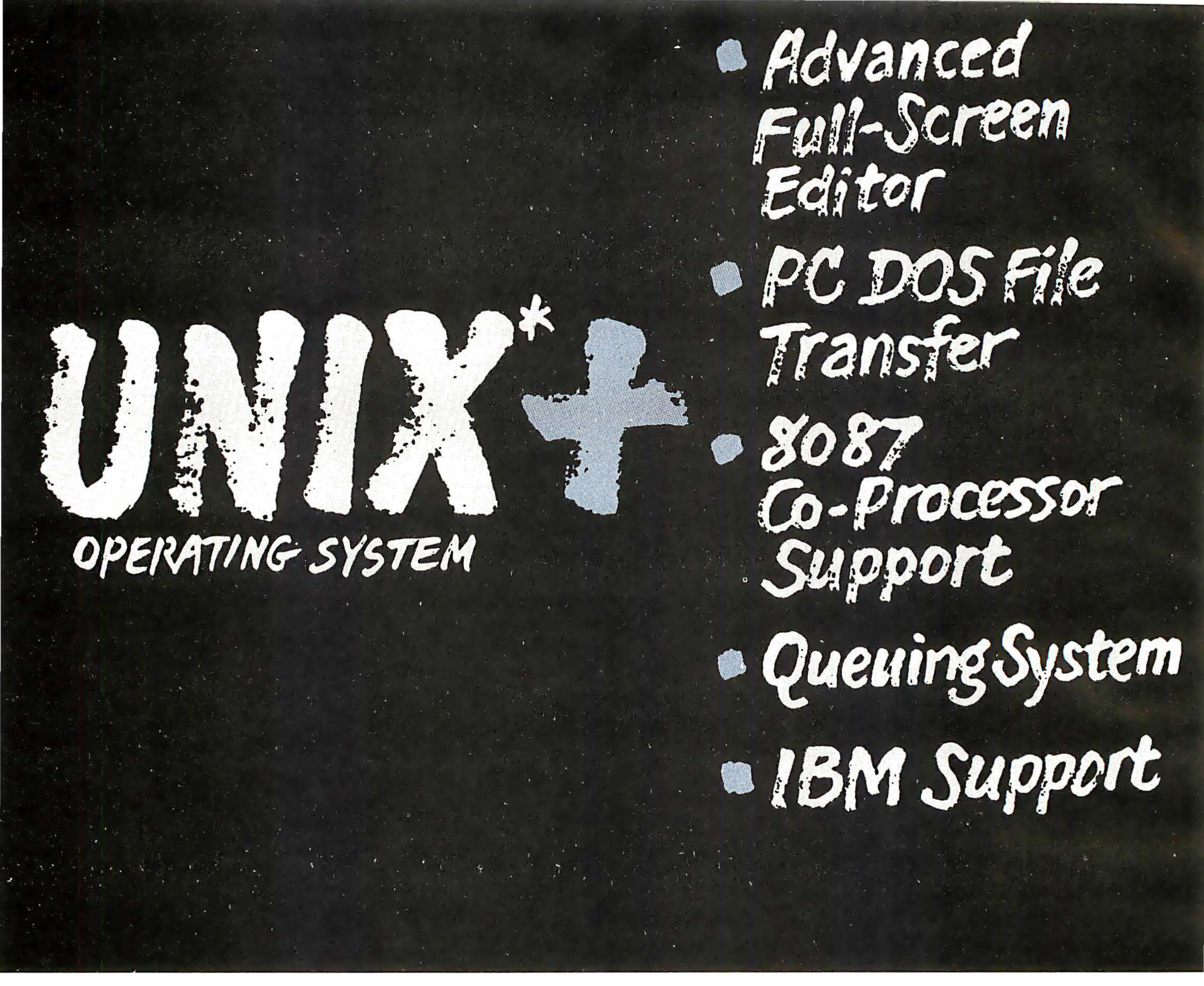
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And PC/IX incorporates many significant enhancements. For example, a new full-screen editor helps you program more effectively. It offers such advanced features as windowing, function-key editing, the ability to execute commands from the editor, and automatic file backup. Beginning users of the editor can rely on a variety of "help" screens.

If you've been using PC DOS, you'll be glad to hear that it can co-reside with PC/IX. And that you can transfer files between the two systems.

PC/IX is specifically designed to take full advantage of the architecture of the IBM PC.

It transparently supports the 8087 Math Co-Processor. And PC/IX automates the management of input/output streams through a multipurpose queuing and spooling system.

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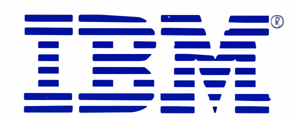
IBM's PC/IX

available, too, including INfort (a FORTRAN compiler with programming tools) and INmail / INnet / FTP (an electronic mail and file transfer facility).†

And because PC/IX is from IBM, you get IBM's quality documentation, as well as IBM service and support.

PC/IX requires 256KB of memory on an IBM PC with fixed disk or an IBM PC XT, PC XT/370 or PC AT.

You'll find PC/IX at your nearest IBM Product Center or your Authorized IBM Personal Computer Dealer. To order, or for more information and the latest list of PC/IX application software, call IBM toll free at 1 800 IBM-2468, and ask for the PC Software Department, Ext. 587. Or call your IBM marketing representative.



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†Developed for IBM by INTERACTIVE Systems Corp.

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of each database); indicate whether you're interested in a person or a subject; enter the person's name or describe the subject in one to three words; optionally refine your search with an additional word or phrase; and review and edit your strategy, if necessary. Search Helper will insert the appropriate adjacency protocols and mask them from you. If the name Ronald Reagan is entered, Search Helper will insert the (f) field operator to limit the occurrence of both words in one field. If you select a subject search and type in the three subject words Computer, Assisted, and Instruction, one on each search line, Search Helper will insert the Boolean AND between the words. Records will be retrieved where these words occur in any order, anywhere in the record. Alternately, if you type in the search phrase Computer Assisted Instruction, Search Helper will automatically insert the Dialog protocol (2w) between words. It will then search this phrase as a string in which the word order must be maintained with, at most, one additional word between each specified term. At present, the only Boolean operator supported by Search Helper is the AND (the most often used operator). IAC is investigating adding the OR operator as well.

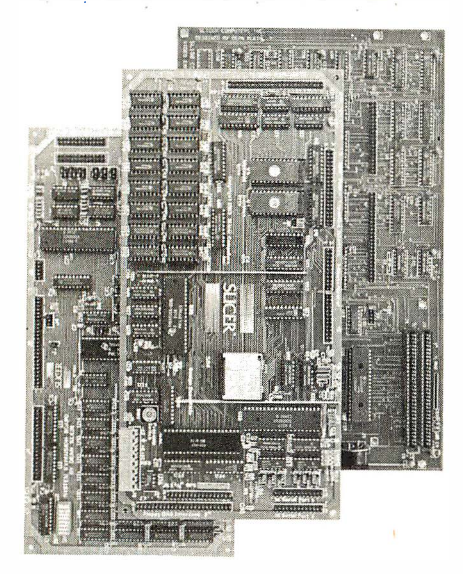
After you have input the search terms, Search Helper's automatic function takes over. It makes the telecommunications connection, performs your search, downloads the 20 most recent citations to your microcomputer, and logs off. There is no user interaction from the time you initiate the search until the download menu appears on your screen, when the information resides in your microcomputer's memory, and no further on-line costs are incurred. At the download screen, you can print selectively or print all citations.

Due to the coverage in the IAC databases and the guaranteed low price per search, this is an appropriate option for many libraries and information centers. Magazine Index covers more than five major U.S. newspapers from 1979; Newsearch offers cover-to-cover indexing of five national newspapers within 24 hours of their publication. Search Helper can be used very effectively by the end user who needs the most recent citations on a topic of interest for a low cost.

Search Helper runs on the IBM PC, Eagle, and Apple II, II+, and IIe. It requires a minimum of 128K bytes of memory on the IBM PC and 48K bytes on the Apple. Search Helper's pricing includes the software and 700 searches on IAC databases for $1750 a year ($2.50 per search). For more information, contact IAC-Information

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Also available: The Slicer 80188 system. 5 1/4" form factor. Call or write for more information.

Operating systems are CP/M 86 by Digital Research, Inc. ($85), and MS DOS by Microsoft Corporation ($175).

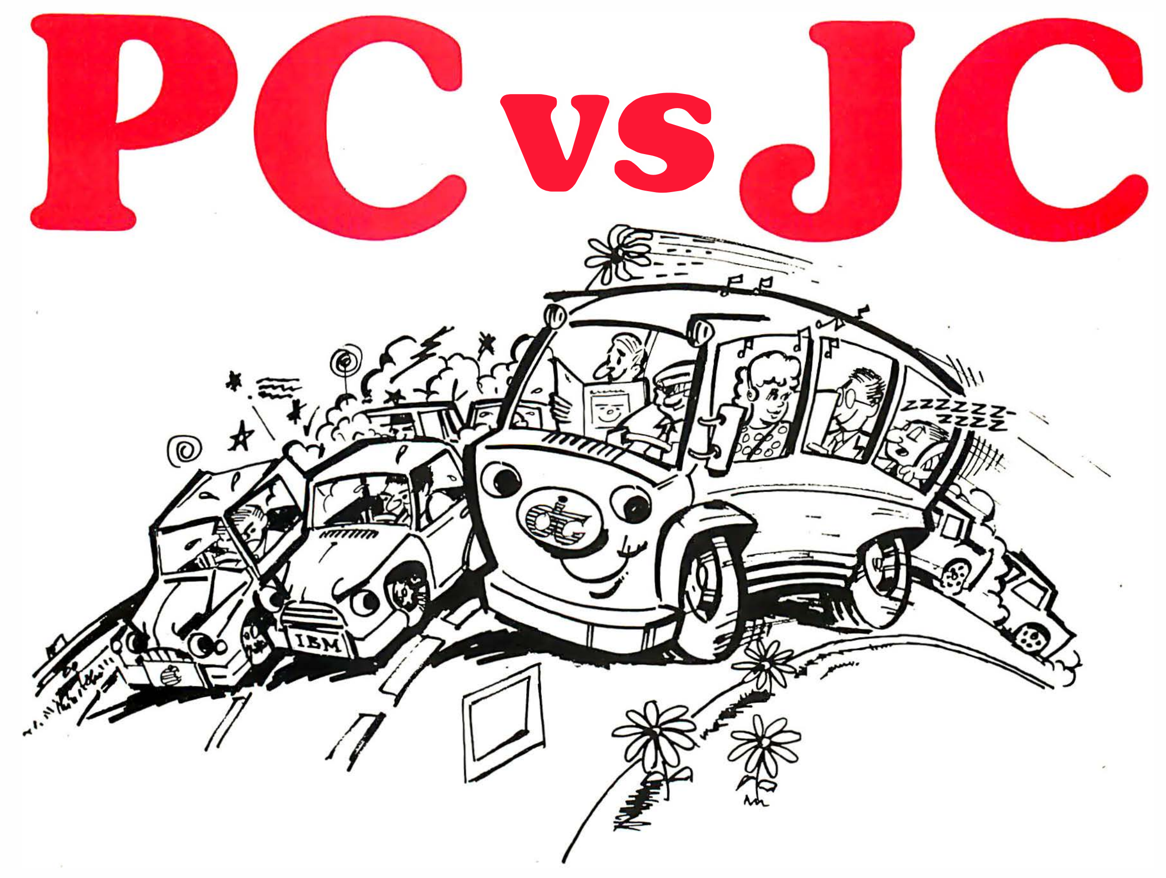
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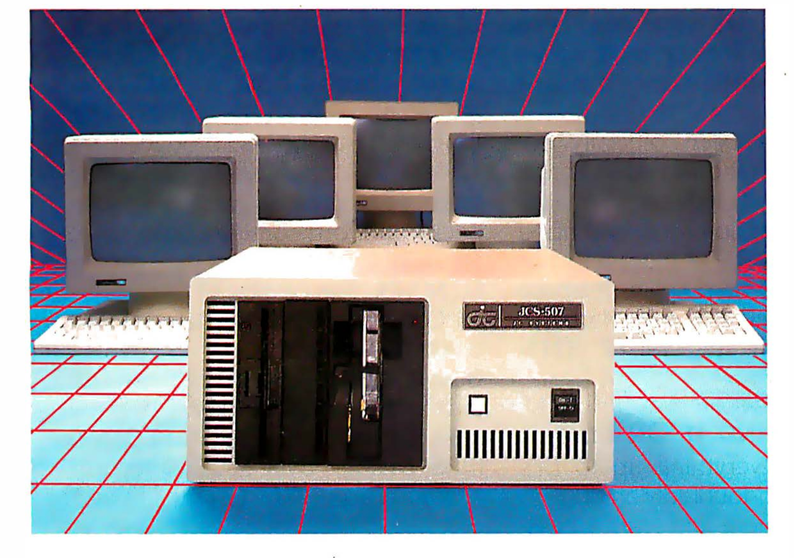
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*TurboDos is a trademark of Software 2000, Inc.
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EasyNet lets you access the Dialog databases on a pay-as-you-go basis.

Access Corporation, 11 Davis Dr., Belmont, CA 94002, (800) 277-8431.

SEARCH MASTER

Search Master, from SDC Information Services, is different from the other microcomputer packages in that it is designed for the information specialist in the corporate environment. It is unique in that it allows the information specialist to design search "scripts" for recurrent searches, where different search terms can be inserted according to need. The user, who may be a scientist, patent attorney, or subject specialist who does not have previous experience in on-line searching, fills in the script's blank spots.

Search Master offers one-time entry of log-on information for many database services, such as SDC's own ORBIT, BRS, Dialog, and NLM. The search strategy is entered off line through a menu-driven system. Search Master will automatically log on to the database system, perform the search, let you interact manually with the database system, store your results, and log off. The search strategy can be saved and used again in different databases. The package will also perform an unattended search and search only the records in the databases that have been added since the last update, thus providing you with a current awareness service.

Search Master runs on the IBM PC and the Burroughs B20. It requires a minimum of 64K bytes of memory, and the list price is approximately $300. For more information, contact SDC Information Services, 2500 Colorado Ave., Santa Monica, CA 90406, (800) 352-6689.

GATEWAY SYSTEM: EASYNET

The latest entry into the database-search market is EasyNet, an intermediary computer, or "gateway system," that lets you access the Dialog databases on a pay-as-you-go basis. The only two requirements for you to use EasyNet are a communicating terminal and a credit card. By dialing 1-800-EASYNET anytime during Dialog's functioning hours, you can perform a search. EasyNet will ask you for your name, credit-card number, and credit-card expiration date, which it will verify immediately. Upon approval of the credit card, menu screens will prompt you as to what you want to search; each choice will offer you a screen with further refinements of the topic.

You input the key search terms, and EasyNet will select the most appropriate database to search. If you have a database in mind, you can also indicate your preference. While you wait, EasyNet will connect with Dialog and perform the search automatically. The 10 most recent references retrieved will be downloaded in bibliographic format (not including abstracts), or, in the case of directory databases, EasyNet will give you the first 500 lines of text. Additional references or lines can be requested for a surcharge. If you want to order the full records including abstracts, or the original article or text, you can indicate your wishes while connected to EasyNet. Your order will be sent by facsimile, overnight or by regular mail. When you call EasyNet, your transmission rate (300 or 1200 bps) will automatically be detected, and screens are 16 lines at most to be compatible with most lap-size portables.

EasyNet has been officially endorsed by the National Federation of Abstracting and Indexing Services (NFAIS). The version I just described is still in Beta test. For more information, contact Richard Kollin, Telebase Systems Inc., 134 North Narberth Ave., Narberth, PA 19072, (215) 664-6168.

WHERE TO FIND IT ON LINE

Having read everything up to this point, you're undoubtedly anxious to get right out there and start accessing all kinds of useful information. The problem is, what's out there and who has it? The following section is an alphabetical sampling of the kinds of topics that may have some interest for you. To use it, call up the database (in parentheses) by referring to the telephone numbers in the text box at the end of the article. After you have become a subscriber (and the requirements for subscription vary) you can get information by requesting a specific service. For example, to find out about agriculture, you first subscribe to BRS or Dialog, then you request access to the AGRICOLA information service at the National Agricultural Library. Once you're connected to AGRICOLA, you can ask a specific question such as the one provided as an example.

AGRICULTURE: Have poultry raisers improved egg production using microcomputers? AGRICOLA (BRS, Dialog). Books and journals catalog of the National Agricultural Library, 1970 to present, 1,920,000 records.

ARTIFICIAL INTELLIGENCE: Who has been investigating applications in Europe? ELCOM (SDC). British and international coverage. Language: French.

BIOMEDICAL: What kinds of computers are used for applications such as hospital intensive-care monitoring systems? AAMSI Communications Network (CompuServe, The Source). Citations to articles in medical and computing journals, including listings of vendors of computerized medical information systems.

BOOKS: I need a book on BASIC programming. BOOKS IN PRINT (BRS, Dialog). Lists books produced by 12,000 U.S. publishers, including scientific, technical, medical, paperbacks, and forthcoming books (up to six months in advance of publication). LC MARK. The catalog of the Library of Congress, 1900 to date, almost 2,000,000 records.

BUSINESS: How much growth can I expect in the robotics industry over the next six months? PTS FORECASTS (BRS, Dialog). Over 800,000 records and forecasts, 1971 to date.

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CHEMICALS: Where can I buy parachloro-aminoanisole hydrochloride? ACS JOURNALS ONLINE (BRS). Full text (25,000 articles) or 18 journals from the American Chemical Society. PHARMACEUTICAL NEWS INDEX (Dialog). 114,000 records, 1975 to date.

CITATIONS: Has this article been cited by other authors? SCISEARCH (Dialog). Indexes 90 percent of the world's scientific and technical literature. Provides for retrieval of other relevant papers by searching for later references to a known work.

COLD WEATHER: How will this equipment perform in cold weather? COLD (SDC). Produced by the Cold Regions Research and Engineering Laboratory of the U.S. Army Corps of Engineers. Covers all disciplines dealing with Antarctica, and behavior of materials and equipment in low temperatures.

COMPUTER-ASSISTED INSTRUCTION: What is written on computer-assisted instruction in literacy programs? NTIS (BRS, Dialog). Government-sponsored research and analyses prepared by federal agencies, their contractors, or grantees. ERIC (BRS, Dialog). Research reports, articles, and projects in education.

CONFERENCES: What engineering societies held conferences in Hawaii in the past two years? MEETING (Questel). Forthcoming conferences, meetings, workshops, exhibitions, and fairs. Covers scientific, technical, and social science fields.

DEFENSE CONTRACTS: Anything on defense electronics and military contracts? DEFENSE ELECTRONICS MAGAZINE (Aerospace Daily Online). Full text of monthly magazine covering U.S. and international military electronics. PTS DEFENSE MARKETS AND TECHNOLOGY (Dialog). Thorough abstracting of more than 100 key defense journals, selective abstracting of 1500 additional journals and newspapers, including DOD contract awards.

EDUCATION: What materials are there for handicapped children? ECER (Exceptional Child Education Resources) (BRS, Dialog). References (print and nonprint) for gifted, disturbed, or handicapped children.

ELECTRONIC PUBLISHING: Anything on electronic publishing? EPA (Electronic Publishing Abstracts) (Pergamon-Infoline). Contains more than 4000 references to literature on electronic publishing. Covers North America, Europe, and Japan, from 1975 to present.

ENGINEERING: What effects has very-large-scale integration (VLSI) had on telecommunications systems? COMPENDEX (BRS, Dialog, SDC). Synopses of worldwide engineering publications and articles covering the entire engineering field.

ENVIRONMENT: In planning for a new

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electric power generating plant, what environmental factors, licenses, permits, and safety considerations should I be aware of? EPIA (Electric Power Industry Abstracts) (SDC). 20,000 citations, 1975 to date. ENERGYLINE (EIC/Intelligence). 30,000 records, 1971 to date.

FIBER OPTICS: How are fiber optics being used in machine vision systems for process control in manufacturing? INSPEC (BRS, Dialog). One of the largest English-language databases in the fields of physics, electrical engineering, electronics, computers and control engineering, and information technology. THE ALTERTEXT REPORT (Newsnet). Full text of newsletter by the same name, includes all fields of telecommunications. 1983 to date. FIBER OPTICS AND COMMUNICATIONS (Newsnet). Full text of newsletter covering industry news, new technology, market trends. 1982 to date.

FOREIGN COMPUTER SCIENCE: What foreign databases can I access for computer information? ZDE (Dokumentation Elektrotechnik). Communications, electrical and electronics engineering. 575,000 citations to worldwide literature. Titles and search terms in English and German, 40 percent abstracts in English, 60 percent in German. SBI (Questel). References and abstracts to the literature of electronics, automation, and robotization. 18,000 records, 1978 to date. Languages: 70 percent French, 20 percent English, 10 percent other. REDOSI (Questel). French and European computer science and public issues. 1974 to present. Languages: 67 percent French, 30 percent English, 3 percent other. TELEDOC (Questel). Telecommunications and electronics. 1972 to present. Languages: 85 percent French and English, 15 percent other. INFOTEL (Sarin). 100,000 citations to worldwide literature on telecommunications and related fields. 1970 to present. Primarily English.

GRAPHICS: What companies are putting computer graphics to profitable use? The S. KLEIN NEWSLETTER ON COMPUTER GRAPHICS (Newsnet). Full text newsletter covering all aspects of computer graphics.

HARDWARE: Who makes teleprinters will a split platen for under $2500? SPECS Service (DRI). Information on more than 12,000 computer and peripheral product models including price, specifications, and performance charactersitics. DATAPRO/ONLINE (DRI). Hardware, software, vendor profiles, and other aspects of the computer market. Approximately 10,000 records. TERMINALS Guide (ECHO). Descriptions of more than 350 terminals.

MARKET INTELLIGENCE: Where can I

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find market intelligence on the computer industry? COMPUTER INDUSTRY MARKET INTELLIGENCE SYSTEM (Computer Intelligence Corporation). Information on computer systems installed at more than 67,000 business locations. Data available per location, industry group, computer system, peripheral devices, software packages. Data collected from user surveys in the U.S. and Canada. 1972 to present. DATAPRO/ONLINE (DRI). Raw data from user surveys on computers, communications equipment, terminals, software, etc. 1983 to date.

NUCLEAR: What computer programs will let me check out the detonator circuit on that nuclear torpedo I'm hiding in the basement? OECD NUCLEAR ENERGY AGENCY DATA BANK (U.S. DOE). Descriptions of approximately 545 computer programs in the field of nuclear energy (available only to staff and contractors of the U.S. Department of Energy.)

OFFICE AUTOMATION: What effects does office automation have on employees? MANAGEMENT CONTENTS (BRS, Dialog, SDC). Business and management topics from over 700 business journals, proceedings, transactions, etc. ABI/INFORM (BRS, Dialog, SDC). Business practice and trends from over 600 top business and management journals.

PATENTS: What Japanese patents on computer clocks have been registered in Europe but not in the United States? COMPUTERPAT (Pergamon-Infoline). Records for all U.S. digital data-processing patent documents as classified by the U.S. Patent and Trademark office. JAPANESE AWARENESS SERVICE (Engineering Information Inc.). English translations of more than 1000 publications each year from Japanese industrial, research, and development organizations.

PERIODICALS: How many journals deal specifically with robotics? ULRICH'S INTERNATIONAL PERIODICALS DIRECTORY (BRS, Dialog). Worldwide publications, includes full buying and ordering information.

PHYSICS: What is the function of Zener diodes? INSPEC (Information Services in Physics, Electrotechnology, Computers, and Control) (BRS, Dialog, SDC). 1969 to present, almost 2 million records.

PRICE FORECASTS: What price changes can I expect in digital integrated circuits over the next few years? ELECTRONIC COMPONENTS PRICE FORECAST (DRI). Quarterly and annual forecasts of invoice prices for active and passive electronic components, and percent price change over a five-year period.

PUBLIC POLICY: What is the public policy on computer crime? PAIS IN-

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The following 18 information services/database vendors were mentioned in this article. With some of the tips mentioned here, and possible those you will discover on your own, the "world's electronic brain" can be made to serve your information needs with minimum fuss, as well as minimum cost.

BRS
1200 Route 7
Latham, NY 12110
(518) 783-1161
(800) 833-4707
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(614) 421-3600
(800) 848-6533

CompuServe Inc.
5000 Arlington Centre Blvd.
Columbus, OH 43220
(614) 457-8600
(800) 848-8990

Computer Intelligence Corporation
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La Jolla, CA 92037
(619) 450-1667

Data Resources Inc. (DRI)
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Lexington, MA 02173
(617) 861-0165

Dialog Information Services Inc.
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Palo Alto, CA 94304
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(800) 227-1927

ECHO Service
15, avenue de la Faiencerie
L-1510 Luxembourg
(352) 20764

EIC/Intelligence
48 West 38th St.
New York, NY 10018
(212) 944-8500
(800) 223-6275

Engineering Information Inc.
345 East 47th St.
New York, NY 10017
(212) 705-7615
(800) 221-1044

International Research & Evaluation
21098 IRE Control Center
Eagan, MN 55121
(612) 888-9635

National Library of Medicine
MEDLARS Management Section
8600 Rockville Pike
Bethesda, MD 20209
(301) 486-6193

Newsnet Inc.
945 Haverford Rd.
Bryn Mawr, PA 19010
(215) 527-8030
(800) 345-1301

Pergamon International Information Corporation (Infoline)
1340 Old Chain Bridge Rd.
McLean, VA 22101
(703) 442-0900

SARIN S.p.A.
Via Bergamini 50
00159 Rome, Italy
06-4363

SDC Information Services
2500 Colorado Ave.
Santa Monica, CA 90406
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(800) 421-7229
(800) 352-6689 (CA only)

Source Telecomputing Corporation
1616 Anderson Rd.
McLean, VA 22102
(703) 734-7500 x546
(800) 336-3366

Swedish Center for Technical Terminology (TNC)
Box 2303
S-103 17 Stockholm, Sweden
(08) 24-9290

Telesystemes—Questel
1625 Eye Street NW, Suite 818
Washington, DC 20006
(202) 296-1604
(800) 424-9600

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Scientific Leaders: We need a prominent lecturer for our yearly meeting . . . ? AMERICAN MEN AND WOMEN OF SCIENCE (BRS, Dialog). Over 130,000 biographical citations on scientists in the physical, biological, and computer sciences, including contact information.

Software: I need information on a microcomputer software package. . . ? MICROSEARCH (The Source). Article abstracts from more than 100 leading industry publications. DISC (BRS). Table of contents and citations to journal literature specializing in microcomputer field. MENU (BRS). Listings of more than 50,000 software packages for micro- and minicomputers, requirements, and prices. MICROCOMPUTER INDEX (Dialog). Citations and abstracts on use and applications of microcomputers. PERIODICAL GUIDE FOR COMPUTERISTS (CompuServe). Citations of articles in over 35 popular computer magazines.

Technology transfer: What's going on in technology transfer? TRANSIN (Questel). Lists offers and requests for industrial techniques and new products. In French and English. INFORMATION AND TECHNOLOGY TRANSFER DATABASE (International Research and Evaluation). Over 3 million citations on science and technology and criminal justice on a variety of subjects. TRADE OPPORTUNITIES (Dialog). Leads to export opportunities for U.S. businesses; supplied by the U.S. Department of Commerce.

Testing: How are micros used in test administration and data analysis? PSYCHINFO (BRS, Dialog, SDC). Published research in psychology and behavioral science, including case studies.

Translation: I need translations for these technical terms in five languages. . . ? TERMDOK (Swedish Center for Technical Terminology). Contains translations and definitions of over 18,000 technical terms in up to 10 languages. Updates about 1500 terms a month. ■

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Microsoft *Flight Simulator*	27.00*
Orion *JBird (QBert Look Alike)*	22.00*
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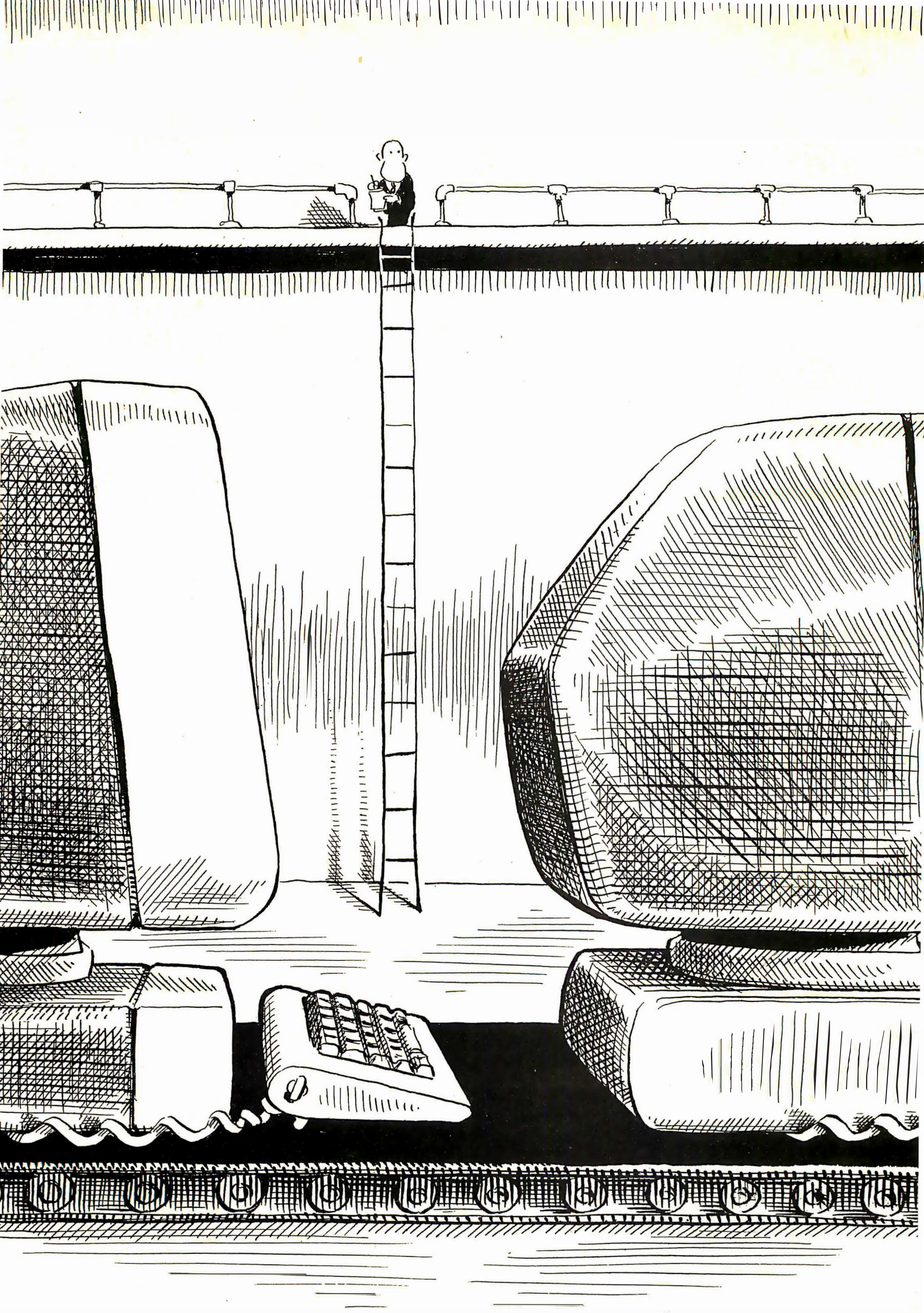
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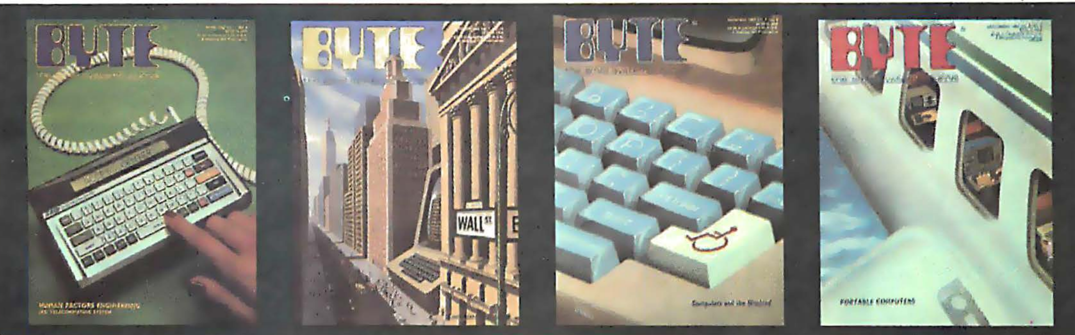
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Reviews

ONE OF THE MOST SIGNIFICANT products announced last year was the Tandy TRS-80 Model 2000. It was one of the first 80186-based computers, and it was the first MS-DOS computer from Radio Shack. Compared with the ubiquitous IBM PC, the Tandy 2000 has a faster processor, better graphics, larger disk drives, and a better keyboard. The only problem has been shortages—a shortage of machines and a real shortage of software—caused by the 2000's incompatibility with the IBM.

Now that there is software for the 2000, and now that the machine is available, the question arises: Just how good a buy is it? Read Mark Jennings's detailed report on this interesting machine for the answer.

Zenith's first MS-DOS machine, the Z-100, was much like Tandy's. In many ways it was a much better machine than the IBM PC. It, too, had better graphics, and it could use expansion boards designed for the S-100 bus. It even had a Z80 coprocessor. But, like the Tandy 2000, it was not completely compatible with the software for the machine from Big Blue.

Zenith, realizing which way the software winds were blowing, went back to the drawing board and produced yet one more IBM clone—the Zenith Z-150—and again seemed to improve on the PC. What were these improvements? How does this machine compare with the IBM PC? And is it really completely compatible? Check the answers to these questions in Wayne Rash's review.

In the old days, a businessperson who wanted to perform some complex financial analysis would have to write, or get someone else to write, a small computer program. Then, a few years ago, the spreadsheet calculator program appeared, and suddenly businesspeople who didn't know the difference between a GOTO and a GOSUB were doing some incredibly complex calculations.

Similarly, most scientists usually approach a computationally difficult problem by writing a program. But a year or so ago, scientists gained a new tool; Software Arts, the people who literally invented spreadsheets, came out with TK!Solver. This product can be loosely described as a spreadsheet for scientists. Alan Miller, a scientist himself, describes this program and examines just how valuable it might be.

In the microcomputer industry, the relative market shares of Apple, Commodore, Kaypro, Radio Shack, and IBM seem to change almost monthly. Who the leader is depends on how you define the term. But when it comes to dot-matrix printers, the leader is, and has been for a very long time, Epson. Epson's latest printer, the LQ-1500, offers very high resolution, very high-quality characters, and high print speeds—but a high price also. Is it worth it? Check the views of Ken Sheldon, one of our Peterborough pundits, in his review of this interesting printer.

And what would an issue be without a word-processor review? This month Ricardo Birmele looks at WordPerfect, a relatively new word processor for the IBM PC. Ricardo puts this program through its paces and attempts to answer the obvious question: Is this package indeed true to its name?

—Rich Malloy, Senior Technical Editor

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ROM 8KB

HDC: FORMATTER, ECC, S/P·P/S CONVERTOR, COMPARATOR, DMA

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HOST (DRIVER/RECEIVER)

MPU Z80

VC O

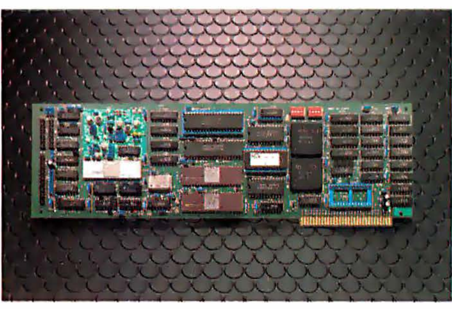
NDC-310

National Computer Ltd.

HOST I/F: SASI
Sector Length: 256B/512B
Data Buffer: Full-sector dual buffer
Data Transfer Rate: **1MB/S** (DMA MAX)
Voltage Source: +5.0V(800mA), +12.0V(100mA)
Size: 5.75" wide, 4.02" deep
Disk I/F: ST506 disk drive compatible

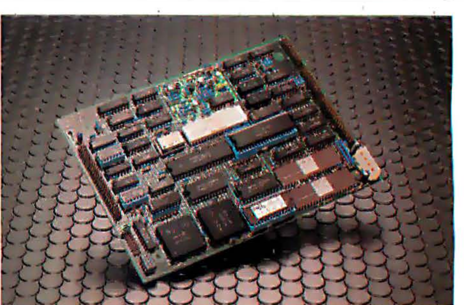
5.25" HDC SERIES





HOST I/F: IBM P.C plug compatible
Sector Length: 512B
Data Buffer: Full-sector buffer
Data Transfer Rate: 500KB/S (DMA MAX)
Voltage Source: +5.0V, 2.0A
Size: 13.20" wide, 4.02" deep
Disk I/F: ST506 disk drive compatible





HOST I/F: SASI
Sector Length: 128B/256B/512B
Data Buffer: Full-sector buffer
Data Transfer Rate: 500KB/S (DMA MAX)
Voltage Source: +5.0V, 2.0A
Size: 7.80" wide, 5.60" deep
Disk I/F: ST506 disk drive compatible

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Circle 284 on inquiry card.

For most of this century a very successful entity existed: the phone company. A few years ago, the phone company decided that breaking itself up would let it offer less service for more money and sell computer equipment. Ever since then, we have been waiting to see its computers.

Recently, AT&T Information Systems (Morristown, New Jersey) consented to send one of its more expensive microcomputers to our computer room. The 3B2/300 is approximately the lowest-priced member of AT&T's 3B2 and 3B5 family.

I say approximately because I am not sure about the prices of the bigger machines. When companies start talking about really big computers, they seem to stop talking about prices. Their attitude is like J. P. Morgan's opinion of yachts: If you have to ask, you can't afford one. Since I'm not Mr. Morgan, there seems to be no limit to the items I cannot afford, but I still want to know how much they cost. In fact, that is usually my first question about any product.

Getting back to the 3B2/300, I can definitely say that its price is about $10,000. It runs on a proprietary AT&T 32-bit microprocessor, and it comes with a 10-megabyte hard disk, a 720K-byte floppy-disk drive, and 512K bytes of memory (using 256K-bit chips). It also comes with UNIX System 5, the most current version of that much-praised operating system.

AT&T has done a fair job of aiming for the microcomputer marketplace. They sent us UNIX versions of Multiplan and dBASE II. Multiplan on the 3B2 ran 2½ times faster than Multiplan on the IBM PC, and just a shade slower than the IBM PC AT.

Despite all the hoopla about UNIX, it is still a rather unfriendly environment in which to work. It has great power, but it is very hard to use. Sometimes, to shut off the machine you have to enter SHUTDOWN -GO -S1 -Y. Not exactly intuitive. Imagine all the less friendly features of MS-DOS 2.0 compounded 10 times over. We've heard so much about UNIX's ability to support friendly "shells" that separate us from its encrypted innards, but if AT&T has one, I have yet to find it.

Despite the present unfriendliness of UNIX and AT&T's rather questionable and untested marketing ability, the 3B2/300 should have a rosy future. UNIX has thousands of devotees, and this is the only multiuser UNIX microcomputer with the AT&T "deathstar" emblem on its front panel. Watch for a review in BYTE.

Buying computer equipment can be a real adventure. Sometimes, no matter how many precautions you take, no matter how many reviews you read, no matter how many friends you ask, you end up with a product that doesn't perform as you would like. On rare occasions the product does not perform at all. Then begins a close relationship with your dealer. With most dealers, you will eventually get a working product, but you still have lost quite a bit of time.

At BYTE we are not immune to this problem. We receive dozens of products on short-term loan, but for evaluation only. The products we actually use to put together BYTE are all purchased by us. We buy them without taking advantage of any editorial discount—usually from one of several local dealers.

Yet with all our experience and the parade of products that passes through our computer room, sometimes we get unpleasantly surprised by the products we purchase.

For example, in our Guide to the IBM Personal Computers (page 238), we published a review of the Popcom modem from Prentice (Sunnyvale, California). This is a pretty impressive 300/1200-bps modem at a good price ($475). We bought a small batch of them, but of the seven I looked at, five were dead on arrival.

It turns out that the Popcoms we received were part of a batch that had been assembled with one faulty chip, which would eventually fail over time. All the modems passed the factory quality-control test and failed later. I have heard that these were the same faulty chips that were in the IBM computer in the space shuttle. (Next time I'm late for work, I'm going to claim that these chips were in my clock radio.) But thanks to our dealer and Prentice, things turned out all right. We returned the modems and quickly received models that have worked perfectly ever since.

In February we ran a review of ProDOS (page 252), Apple Computer's new operating system for the Apple IIe. This operating system offers improved performance over the previous Apple DOS 3.3. But, since most of our readers were still using DOS 3.3, we have been using the older operating system in our benchmark tests. Starting this month, however, we will be using ProDOS as the standard operating system.

We were somewhat surprised at our results with ProDOS. Most of the benchmarks were faster, but two of them (the Format/Disk Copy and File Copy) were slower. Also, we found out that a ProDOS version of Multiplan wouldn't be available until the first quarter of next year. For obvious reasons, the Multiplan tests are still done with DOS 3.3. As soon as a ProDOS version of it becomes available, we will use it.

—Rich Malloy, Product-Review Editor

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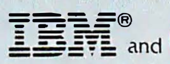
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The Tandy Model 2000

A compromise between IBM PC compatibility and high performance

BY MARK S. JENNINGS

After six months of intensively using the Tandy 2000 alongside an IBM PC, I can say without reservation that the 2000 is the superior computer. It is noticeably faster and has better display options, a superior keyboard, higher disk-storage capacity, and more room for expansion. You should choose between the two computers based on whether you are willing to accept the limited availability of software and hardware in order to gain much higher performance.

System Overview

The Tandy 2000 is a low-profile unit with a thin, detachable keyboard. You can set either a monochrome or RGB (red-green-blue) monitor on top of the system unit, or Tandy will sell you a stand to mount the system unit vertically on the floor.

Tandy used plastic as the main construction material; RF (radio frequency) shielding is accomplished with foil lining and metal access covers. I'm not big on plastic, but it makes the 2000 lighter than the IBM PC. The color is an attractive eggshell white.

A small but important feature of the 2000 is a front-panel reset button. Some people complain that hardware reset buttons cause accidents; however, the 2000's reset button is deeply recessed on the unit's front panel to prevent problems. A hardware reset button ensures that you can always reboot the system, even after a serious software crash. You can also use the IBM PC's Control-Alternate-Delete combination to boot the 2000.

The basic 2000 system includes 128K bytes of RAM (random-access read/write memory), dual 5¼-inch floppy-disk drives, a monochrome display adapter, a parallel port, and a serial port. Adding Tandy's VM-1 monochrome monitor produces a working system for about $3000 list. You can substitute a 10-megabyte hard-disk drive for one of the floppies; this system (with monochrome monitor) lists for approximately $4500. Monochrome graphics requires an expansion board, and if you want color graphics you'll need a memory-chip upgrade kit and Tandy's CM-1 RGB monitor. All told, a two-floppy, color graphics system runs about $4200.

Internal Layout

A large main circuit board lies horizontally at the base of the 2000's system unit. Cables interconnect the main board to the power supply and disk drives. While the 2000 has slots for expansion boards, these boards do not connect directly to the main board. Instead, a small expansion bus board rises vertically from a connector on the left side of the main board (see photo on "At a Glance" page). Expansion boards slide in horizontally from the back and connect to the expansion bus board. Four expansion board slots are provided.

This method of plugging in expansion boards has several advantages. First, you do not need to open the computer's case to plug in a board—just pop two plastic clips on the back panel of the computer, slide the board in until it seats, and re-pop the clips. You don't even need a screwdriver. Second, the entire rear edge of the expansion board can have I/O (input/output) connectors. This alleviates the "connector space squeeze" that afflicts IBM PCs with multifunction expansion boards. Third, keeping the expansion connectors on a separate board allows plenty of space for big connectors. The 2000 uses a 96-pin three-tiered Euroconnector rather than the usual card-edge connector. The relatively large number of pins provides designers of expansion boards with more flexibility.

A disadvantage of the 2000's arrangement is that you need two connectors instead of one to connect each expansion board to the main board, perhaps degrading reliability a bit.

Processor

The 2000 uses the Intel 80186, an improved descendant of the 8086/8088 micropro-

(continued)

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cessors used by the IBM PC and most other MS-DOS computers. Compared to the 8088 as used in the IBM PC, the 80186 has a faster clock speed (8 MHz versus 4.77 MHz), uses a full 16-bit data bus, and includes a number of functions for which the 8088 requires extra support chips. All these improvements do not compromise software compatibility; the 80186 can execute the full 8086/8088 instruction set and has a few new instructions of its own. The 80186 has one drawback: limited availability. Intel can't produce enough to meet demand.

Do these features translate into improved performance? Yes and no. Operations that are "processor-intensive" (such as recalculating a spreadsheet) run about two to three times faster on the 2000 than on the IBM PC. This peps up certain programs. The "At a Glance" benchmarks indicate the performance improvement you can expect in this area.

Unfortunately, the effective operating speed of many programs is limited by disk I/O speed rather than processor speed. There is little significant difference in disk I/O speed between the 2000 and the IBM PC as shown in the benchmark graphs. This means that programs that read and write disk files extensively (most compilers) will not show as much of a performance increase when run on the 2000.

The key to fast execution of a program that does extensive disk I/O is to use a hard disk or, better yet, a RAM disk. The 2000 has a hard-disk option but doesn't yet have RAM-disk software. Tandy has contracted for the development of a RAM-disk package and it might be available by the time you read this. Until a 2000 RAM disk is available, an IBM PC with a RAM disk can outpace a 2000 when running programs with heavy disk I/O.

If your program requires floating-point arithmetic operations, a numeric coprocessor (such as the Intel 8087) can be the key to fast execution. The 80186 can use the 8087 but it needs the 82188 controller chip to coordinate. Unfortunately, the 82188 is in short supply and Tandy doesn't expect to release a coprocessor option until early 1985. It won't require any expansion slots; the coprocessor option will be a small board that plugs, piggyback style, onto the main board. With this option, the 2000 should be among the fastest number crunchers available short of a VAX.

MEMORY

The basic 2000 comes with 128K bytes of RAM chips mounted on a small piggyback board that connects to the main board (see photo 1). You add the next 128K with another small piggyback board. After this, you add memory with expansion boards that use the expansion bus; each board comes with 128K bytes and sockets for another 128K. Two expansion boards give a total maximum memory size of 768K bytes, as compared to the IBM PC's maximum memory limit of 640K.

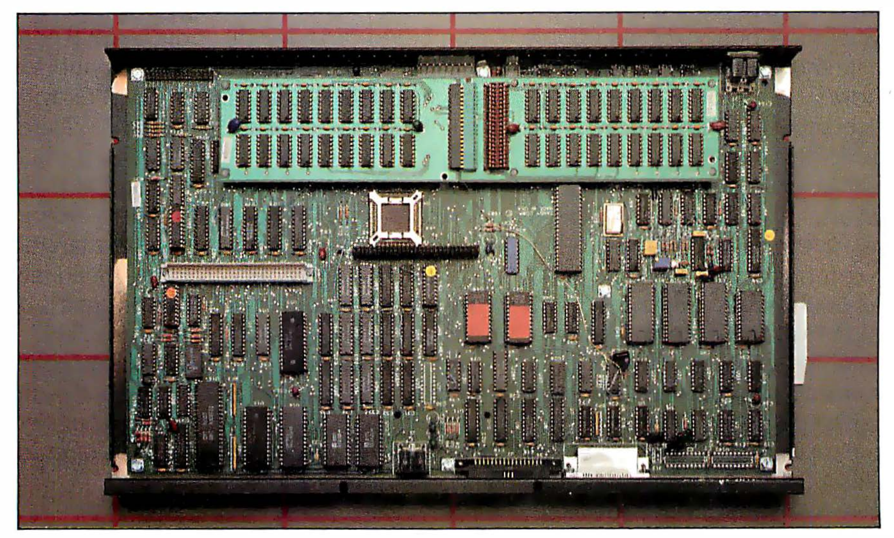


Photo 1: *The 2000's main circuit board with standard and optional piggyback boards installed, each with* 128K *bytes of* RAM. *The large white connector on the left is for the expansion bus board.*

Another interesting feature of the 2000 is its RAM-based character fonts. While the IBM PC stores the pixel maps defining each character font in ROM (read-only memory), the 2000 stores the maps in dedicated static RAM on the main board. This simplifies redefinition of character fonts. (But don't expect to see proportional spacing on the 2000's display like that of Apple's Macintosh and Lisa; the 2000's display system is still basically character-oriented.)

In general, the 2000 avoids the use of ROM, using only 16K bytes for boot-up. The 2000 loads the BIOS (basic input/output system) to RAM from disk rather than using ROM as the IBM PC does. This lets Tandy make frequent changes to the BIOS; however, this flexibility might lead to software problems unless Tandy makes sure that each new version of the BIOS is completely compatible with previous versions. The problem has already surfaced in Tandy's version of SuperCalc3, which uses a BIOS that is incompatible with earlier versions. You have to reboot the system before and after running SuperCalc3 in order to run other programs. Tandy has acknowledged the problem and claims to be working on a solution.

Another area where the 2000 uses RAM rather than ROM is in its GW-BASIC interpreter. The 2000 loads the entire interpreter into RAM from disk, whereas the IBM PC includes the core of its BASIC interpreter in ROM.

The 2000's heavy use of RAM for the operating system tends to eat into the RAM available for programs. Equipped with only the basic 128K bytes of RAM, a 2000 has only about 75K bytes of RAM left after loading

(continued)

AT A GLANCE

Name
Tandy Model 2000

Manufacturer
Tandy Corporation
1500 One Tandy Center
Fort Worth, TX 76102
(817) 338-2390

Components
Size: 19 by 6 by 16 inches (system unit), 16.3 by 1.2 by 7.9 inches (keyboard)
Weight: 23 pounds (system unit), 2.8 pounds (keyboard)
Processor: Intel 80186
Memory: 128K bytes standard, up to 768K bytes optional
Display: 12-inch green phosphor or 14-inch RGB, nonstandard input
Keyboard: Detachable with 90 keys, standard layout, 12 function keys, separate cursor control and numeric keypad
Mass storage: Two 5¼-inch, 720K-byte, floppy-disk drives
Expansion: Four slots, nonstandard
I/O interfaces: RS-232C serial port, parallel printer port

Software
MS-DOS 2.02, GW-BASIC interpreter

Optional Hardware

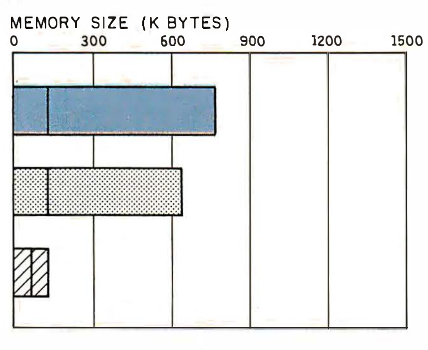
Monochrome graphics	$449
Color-graphics chip kit	$199
Mouse	$100
Mouse/clock controller	$120
Monochrome monitor	$249
Color monitor	$799
128K RAM expansion kit	$299
External 256K expansion board (with 128K)	$499
Internal 10-Mb hard disk	$1699

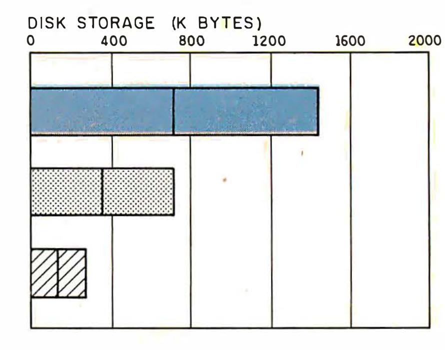
Documentation
Introduction to the Model 2000: 69 pages
MS-DOS Manual: 291 pages
BASIC Manual: 366 pages
Reference Guide to the Model 2000: 51 pages

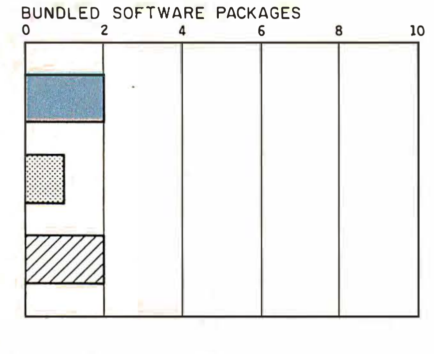
Prices

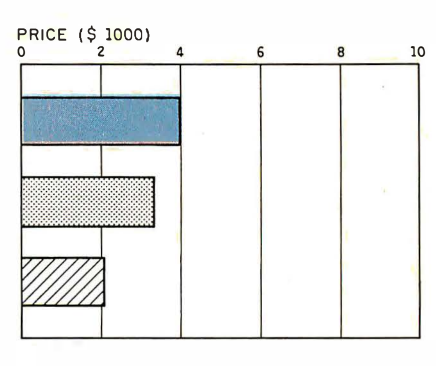
Base system price	$2750
Monochrome system with 256K, color/graphics capability	$3946
Color system with 256K	$4496











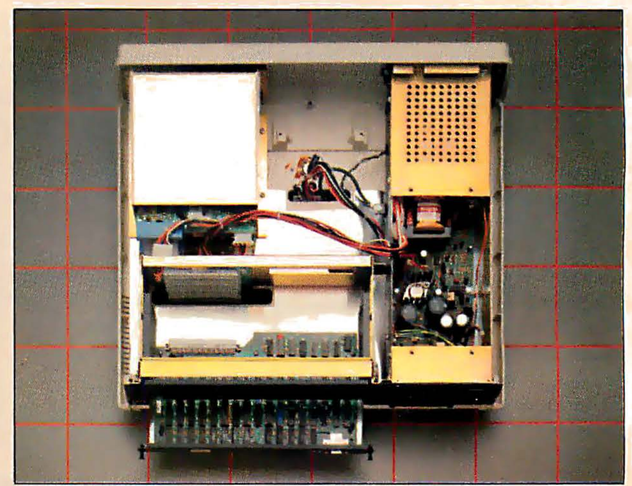
TANDY 2000 IBM PC APPLE IIE

The Memory Size graph shows the standard and optional memory available for the computers under comparison. The Disk Storage graph shows the highest capacity of one and two floppy-disk drives for each system. The Bundled Software graph shows the number of software packages included with each system.

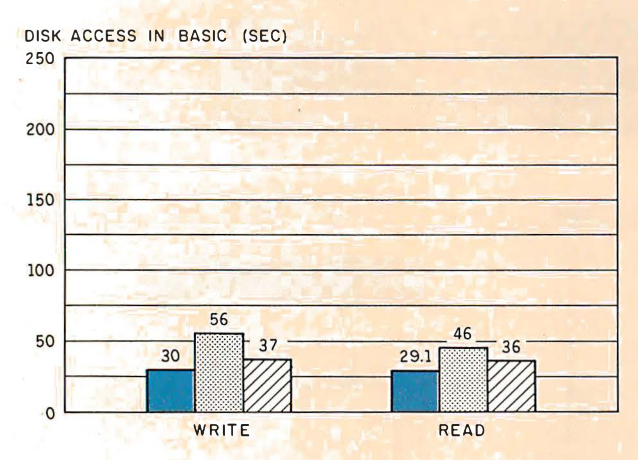
The Price graph shows the list price of a system with two high-capacity floppy-disk drives, a monochrome monitor, graphics and color-display capability, a printer port and a serial port, 256K bytes of memory (64K for 8-bit systems), the standard operating systems for the computers, and their standard BASIC interpreters.

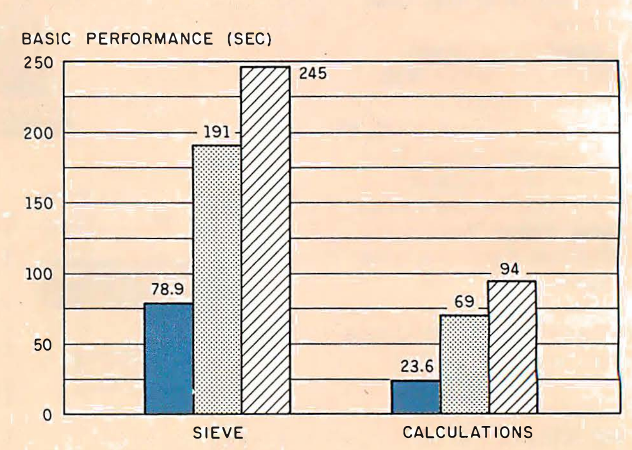


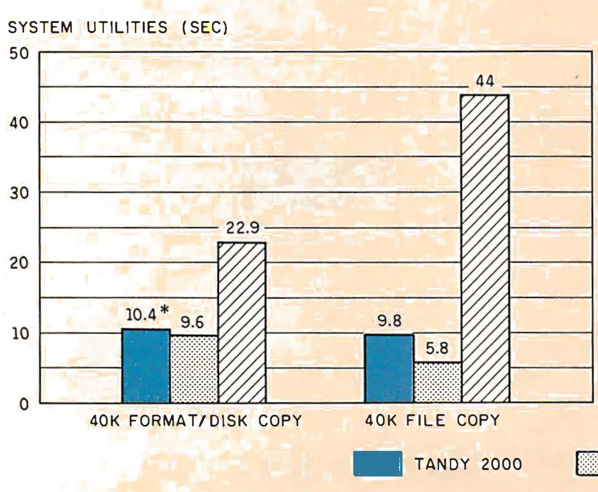
The back panel of the Tandy 2000. The serial and parallel ports are along the bottom.

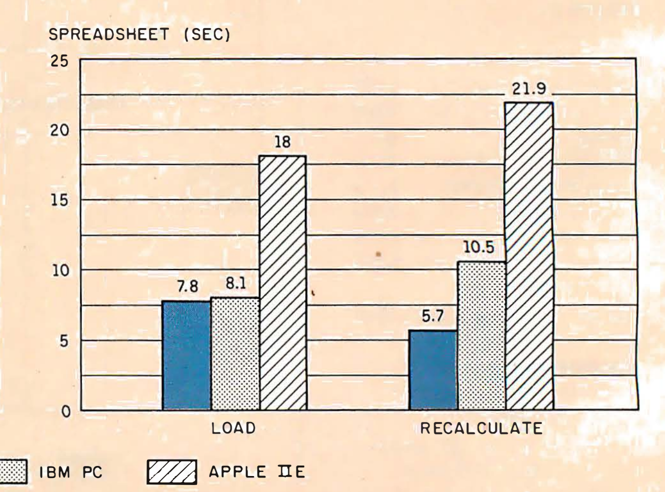


Removing the 2000's top reveals the disk drives (top left), power supply (right), and expansion bus (bottom left).









TANDY 2000 IBM PC APPLE IIE

In the Disk Access in BASIC graph, a 64K-byte sequential text file was written to a blank floppy disk, then read. (For the program listings see June BYTE, page 327, and October, page 33.) The Sieve column shows how long it takes to run one iteration of the Sieve of Eratosthenes. The Calculations column shows how long it takes to do 10,000 multiplication and division operations using single-precision numbers. The System Utilities graph shows how long it takes to format and copy a disk (adjusted time for 40K bytes of disk data) and to transfer a 40K-byte file using the system utilities. The Spreadsheet graph shows how long the computers took to load and recalculate a 25- by 25-cell spreadsheet where each cell equals 1.001 times the cell to its left. The spreadsheet program used was Microsoft Multiplan. The tests for the Apple IIe were done with the ProDOS operating system (except for the spreadsheet test, which was done with DOS 3.3). The IBM PC was tested with PC-DOS 2.0. *Note: Format and Disk Copy are separate operations on the Tandy 2000.

the operating system. This is insufficient for most programs; most users will want to upgrade their 2000s to at least 256K.

DISPLAY

The Tandy 2000 offers a number of options for different combinations of text, monochrome graphics, and color graphics. A text system requires only the VM-1 green monitor—no expansion board. This is a superb system for word processing. Characters are crisply formed with an 8- by 16-pixel matrix against a dark background. This display is slightly superior to the IBM PC's excellent monochrome display.

By adding a graphics expansion board, you can display 640- by 400-pixel monochrome graphics on the VM-1. For color, you need a memory-chip upgrade for this board, as well as the CM-1 RGB monitor. This provides for 640 by 400 graphics in 8 colors (selected from 16 possible colors). This color system looks spectacular—easily producing the most attractive color displays I have seen on a mass-market microcomputer. The resolution, focus, and color rendition (particularly yellow) are excellent.

Unfortunately, the 2000's color graphics are seriously flawed. When operating in the graphics mode, the computer displays text at a snail's pace, more than nullifying its speed advantage over other systems. An odd hardware configuration is to blame. With a text-only system or when using the monochrome-graphics option, the 2000 uses a high-speed 9007 CRT controller chip that scrolls text very quickly. But when the color-graphics chips are added, the 9007 can no longer be used to generate text in the graphics mode. Instead, text must be laboriously generated in software.

The text display in color-graphics mode is very slow. I wrote a short BASIC program that displays the words "Hello, BYTE" on the screen 100 times. It ran in less than 2 seconds on a text-only 2000 but took over 30 seconds on a color-graphics system. I obtained similar results when I performed the test in Pascal.

With programs that switch back and forth between text and color-graphics modes, such as Lotus 1-2-3, this performance penalty will go largely unnoticed. But programs that stay in the graphics mode continuously, such as the BASIC interpreter, will be severely hampered when run with the color-graphics system.

If you know that you will not be using any graphics, you can reconfigure the 2000 as a text-only system. The manual tells you to tap the F12 key when the disk drive flashes during the boot-up procedure, and if this doesn't work, to "repeat the procedure, tapping the key as quickly as possible." I tried and could reconfigure my system (some of the time) by furiously hitting the F12 key for several seconds during the boot-up process. It turns out that the manual is wrong—you're supposed to hit the F12 key when the Caps and Num Lock indicators on the keyboard flash. This reconfigures the system and provides normal text display speed, but it limits you to text display until you reboot the system. Even when you know how to do it, this is an inconvenient way to reconfigure the system.

One aspect of the 2000 that I like is that it doesn't require a separate monitor if you want both high-quality text and graphics. The graphics systems (monochrome or color) display text with the same resolution offered by the text-only system. And the 2000's RGB monitor is acceptable for text display (although definitely not as good as the monochrome monitor).

Another drawback: both the VM-1 and CM-1 monitors are specifically designed to work with the 2000 and won't work with any other computer system. Conversely, no other monitors will work with the 2000.

KEYBOARD

The 2000's keyboard (photo 2) is a strong point. The layout is conventional; Tandy wisely avoided IBM's controversial placement of an extra key near the left shift key. The cursor controls are arranged separately from the numeric keypad in an upside-down "T" arrangement. The Caps and Num Lock toggles have status lights so you won't forget when they're on.

Another nice feature is a Hold key that stops display scrolling; the IBM PC requires a difficult combination of Ctrl and Num Lock to do the same thing. Unfortunately, the 2000's Hold key is right above the up-arrow cursor key where it is too easy to hit accidentally. Finally, the 2000 has 12 function keys that are arranged horizontally across the top of the key-

(continued)



Photo 2: *The Tandy 2000 keyboard features 12 function keys, Caps and Num Lock keys with lighted indicators, and a large Enter key.*

The Tandy 2000's HFORMAT command can keep you from accidentally trashing the entire contents of your hard disk.

board instead of vertically on the left side. This arrangement is better than IBM's for associating the keys with on-screen menus.

Keyboard touch is very subjective. I find the 2000's touch to be nearly perfect—fairly light but not "nervous." One aspect many will appreciate is the lack of clickety-clackety noise from the keyboard.

Disk Storage

The basic 2000 comes with two half-height, 5¼-inch, Mitsubishi M4853 floppy-disk drives. Disk-storage capacity on the 2000 is twice that of the IBM PC (720K versus 360K), a result of doubling the number of tracks (and track density) from 40 to 80 tracks per disk. This makes a world of difference for many uses of the machine. The 2000's drives are quiet and the disk ejection mechanism works well. One complaint—as in its earlier computers, Tandy put the A drive on the bottom and the B drive on the top.

The hard-disk 2000 system substitutes a Tandon TM502, dual-platter, 5¼-inch, 10-megabyte Winchester hard-disk drive for one of the floppies. A hard-disk system that retains both floppies is not currently supported but probably will be eventually.

Software

For this review, I used Tandy's recently released MS-DOS version 2.02. The differences between the 2000's and the IBM PC's MS-DOS implementations are fairly minor. The 2000's FORMAT command has a few extra options and the commands for copying and comparing disks are slightly different. For example, DISKCOPY does not automatically include FORMAT—they are two separate steps.

One small but important feature of the 2000's MS-DOS is the use of separate commands for formatting a floppy and a hard disk. The IBM PC uses the same command to format both and can cause you to accidentally trash the entire contents of the hard disk. The 2000 uses a completely separate command (HFORMAT) that is much less likely to cause this problem.

One MS-DOS command conspicuous by its absence from the 2000 is MODE. On the IBM PC, you can use this command to switch display modes, configure parallel/serial ports, and redirect output from the parallel port to the serial port. Without this command, accessing the 2000's serial port directly from the operating system is difficult. The lack of any redirection provision also hurts; it virtually requires that you have a printer with a parallel interface. Tandy has apparently recognized the need to address this problem: the company says it has a new version of MS-DOS coming that includes a MODE command.

Tandy should also include some diagnostics with the basic 2000 system. The MS-DOS disk does not contain any diagnostics programs, and I could find no reference to diagnostics in any of Tandy's documentation.

Microsoft's GW-BASIC interpreter is included with the 2000 system. The Tandy 2000 differs from the IBM PC in that the interpreter is implemented as a single program (BASIC.EXE), which includes graphics commands. The 2000's BASIC automatically senses whether you have installed the graphics expansion board. If you have, the graphics routines work; otherwise, you get a syntax error whenever you attempt to execute a statement that uses a graphics routine.

Although the 2000 has more options for color and resolution than the IBM PC, the 2000's BASIC includes the lower-resolution modes that the IBM PC uses. All other things being equal, most IBM PC BASIC programs should run on the 2000 *without* changes.

Application Software

The question most people ask about application software for the 2000 is "Will it run Lotus 1-2-3?" With the recent release of a 2000 version of the popular Lotus program, Tandy can now respond with a definitive yes.

Model 2000 owners have four basic ways to get the application software they need. First, Tandy markets many mainstream MS-DOS products under its own label, customized and optimized for the 2000 with documentation in the standard 2000 gray binders. A second option is Tandy's Express Order program. With this system, you order the software you want from a catalog at your local Radio Shack Computer Center. Within two or three days, the software is express shipped to your dealer so you can pick it up. Programs ordered through the Express Order program will usually be "generic" MS-DOS and might or might not take advantage of certain 2000 features.

A third option is the Reviewed Software catalog, which lists software that Tandy has tested and knows will work on the 2000. You order the software directly from the vendor or through a distributor. The fourth option is to buy IBM PC programs, some of which will work fine while others won't even load from disk.

I was able to briefly test Tandy 2000 versions of 1-2-3, Multiplan, SuperCalc3, MultiMate, dBASE II, WordPerfect, and all the Microsoft compilers and assemblers. All performed well on the 2000 and most seemed significantly faster and more responsive than the IBM PC versions.

Certainly the most impressive of these packages is 1-2-3. The software is extremely quick and responsive on the 2000. Because the 2000's hardware configuration is more stable, fewer ancillary files hang around on the disks and you do not need to configure the system to get it up and running. I was displaying spectacular seven-color bar charts with 640- by

(continued)

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400-pixel resolution three minutes after taking 1-2-3 out of the box.

IBM PC Compatibility

Because the 2000 runs MS-DOS and uses a software-compatible microprocessor, it offers some compatibility with IBM PC software. To run IBM PC software, the Tandy 2000 must be able to read PC disks, i.e., have the same disk format. Futhermore, the software itself must interact with the 2000's hardware through MS-DOS system calls or through compatible BIOS calls.

As for disk-format compatibility, numerous reviewers have commented that the 2000 can read but not write to IBM PC disks. This is not entirely true. What the 2000 could not do, until recently, was *format* an IBM PC disk. To write a file to an IBM PC disk, the disk had to be formatted on an IBM PC. Thereafter, the 2000 could read, write, and erase files just as if the disk were formatted on the 2000.

Apparently, however, this formatting limitation has been alleviated. Tandy is now including an extra formatting program (PC Maker) that allows the 2000 to format IBM PC disks. According to Tandy, all registered 2000 owners will receive this upgrade.

Granted, I have had some minor erratic problems in getting the 2000 to read a file written by an IBM PC and vice versa. After transferring hundreds of files (text and binary) between the 2000 and an IBM PC, I have yet to be thwarted—although a few transfers have been a bit stubborn. Part of the problem might be due to individual head alignment and rotation speed variations in the disk drives; the bottom drive on my 2000 seems to read and write to IBM PC disks much more reliably than the top drive. Also, disks that are relatively "fragmented" (due to repeatedly writing and erasing files) are less likely to work. So far, using the bottom drive on the 2000 and a newly formatted IBM PC disk has been a surefire way of transferring any file.

Suppose you've put your favorite IBM PC program on a disk that the 2000 can read. Will it run? That depends on how the program communicates with the computer hardware.

If the program calls the PC hardware directly, it will definitely not run; the memory maps and I/O ports of the 2000 and the IBM PC are very different. This rules out copy-protected programs, programs that write directly to display memory (e.g., some programs with high-speed graphics), and many communications programs.

If the program communicates with the hardware through the BIOS, it will probably run. However, the 2000 uses a different system for character attributes and graphics that can cause incompatibility. One programmer's utility that I use in my work uses the BIOS to play around with different combinations of color and character attributes (bold, underline, blinking) depending on whether it is run on a monochrome or color system. This program does not work properly on the 2000. It is a fact of life that most sophisticated application programs go outside the operating system to implement special features.

As for IBM PC hardware compatibility, there is none. The expansion bus used on the 2000 is completely different from the IBM PC's. Aftermarket hardware vendors will need to develop completely separate products for the 2000.

I called the major IBM PC aftermarket board developers (Tecmar, AST Research, and Quadram) and asked them if they had any plans to develop products for the 2000. For the most part, their attitude was "wait and see."

Documentation

The 2000 comes with four pieces of documentation. *Introduction to the Model 2000* is aimed at novice users; it presents a short overview of the system. The MS-DOS and BASIC manuals are much larger and are similar in size and format to the IBM PC's DOS and BASIC manuals. Finally, Tandy provides a pocket-reference guide to the system. For some reason, however, Tandy doesn't put the loose-leaf MS-DOS and BASIC manuals in slipcases; this tends to add to bookcase clutter.

Overall the 2000's manuals, while attractive and easy to use, are less than complete. A great deal of technical information is left out of the MS-DOS manual. For example, it devotes a scant two pages to the subjects of configuring a system and device drivers. The 2000's manual is also missing key documentation of batch commands. Finally, the general manual, *Introduction to the Model 2000*, is much less comprehensive than IBM's *Guide to Operations*.

Some information missing from the standard manuals is in the recently released technical manuals: *Programmer's Reference* and *Technical Reference*. The programmer's reference manual gives information on how to access MS-DOS and the BIOS from assembly language. The technical reference manual provides detailed information about the 2000's hardware. It covers every circuit in great detail and even includes manufacturers' data sheets for most of the critical chips in the system. Unfortunately, the technical manual seldom presents any overview information that puts the details in perspective; I found it nearly impossible to read.

Service and Support

With well over 1000 Radio Shack Computer Centers (of which about 400 have complete service facilities), the 2000 is well supported in the field. My 2000 has performed flawlessly, so I have no direct experience with Radio Shack's service department. I have heard that it is above the industry average.

Tandy provides a customer service support number to help with hardware and software problems. I called

(continued)

WHAT AN ASSAULT ON MT. EVEREST TAUGHT US ABOUT HIGH PERFORMANCE PERSONAL PRINTERS.

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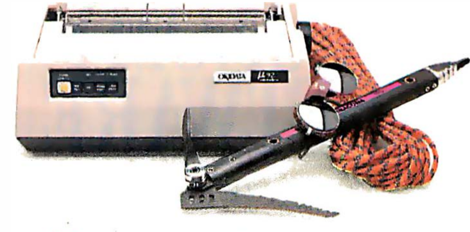
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The Tandy 2000 breaks no new ground; it is a refinement of the basic IBM PC *system.*

it with some typical problems and was favorably impressed. I also called Tandy's headquarters in January 1984 when the 2000 had been on the market for a few weeks. I had not yet purchased the computer and had a number of technical questions. After getting passed around for a few minutes, I was able to talk to a knowledgeable technical person. This is something I have been unable to do with IBM and Apple.

Gripes

Tandy seems to have an aversion to DIP (dual-inline package) switches; changing the 2000's hardware configuration often requires cutting traces on circuit boards. For example, adding the color-graphics chip kit to the graphics expansion board requires cutting a trace. Adding a numeric coprocessor will involve major surgery; the technical reference manual mentions cutting several traces on the non-visible side of the main board. How expensive can it be to add a DIP switch or a couple of pins that can be jumpered?

Perhaps Tandy wants to discourage customers from installing options on their own. The thought of cutting into a circuit board will scare many customers down to their local Computer Center. This hypothesis is confirmed by other aspects of the 2000's design. Adding the 128K-byte internal memory board requires you to take the bottom cover off the computer. Tandy doesn't like you to do this; a prominent seal warns about loss of warranty coverage. If you have it done at a Computer Center, you pay $15. I would have preferred that Tandy include 256K in the basic computer or, better yet, put in sockets to let you install your own memory chips.

I think that requiring a separate (and expensive) internal memory board has more to do with marketing than with engineering. Tandy aggressively prices the basic 128K, two-floppy system at $2750. Adding the monochrome monitor raises the price of a working system to $3000—quite a bargain considering how much computer you are getting.

Tandy makes money by selling the add-ons people inevitably buy. If you decide you want a 512K color system, you will need to add the graphics board ($450), color-graphics chip kit ($200), RGB monitor ($550 more than the monochrome), 128K internal memory board ($300), 128K external memory board ($500), and a 128K chip kit ($300). Suddenly, your $3000 computer costs $5300. Some of these prices seem a bit high.

A gripe list wouldn't be complete without mentioning the constant scheduling slips that have plagued the entire 2000 program. I know that all computer manufacturers are optimistic in predicting when items will be on the market, but Tandy has pushed optimistic scheduling to new extremes. I especially dislike the way Tandy lists items in its catalog that are not available. For example, MultiMate was listed as available in a January 1984 catalog; it finally appeared in June. Any prospective 2000 purchaser should beware of Tandy's "Real Soon Now" promises.

Conclusions

Unlike Apple's Macintosh, the 2000 breaks no new ground; it is a refinement of the basic IBM PC system. If you want an "IBM PC type" computer, you have three basic choices: you can go with Big Blue, you can save a little money and buy an IBM PC-compatible, or you can buy a higher-performance version of the IBM PC.

The 2000 is definitely the computer to consider for the last option. In nearly every measurable way, the 2000 is superior to the IBM PC. And when higher-performance software comes into wider use, the 2000's advantages will become even more evident. ■

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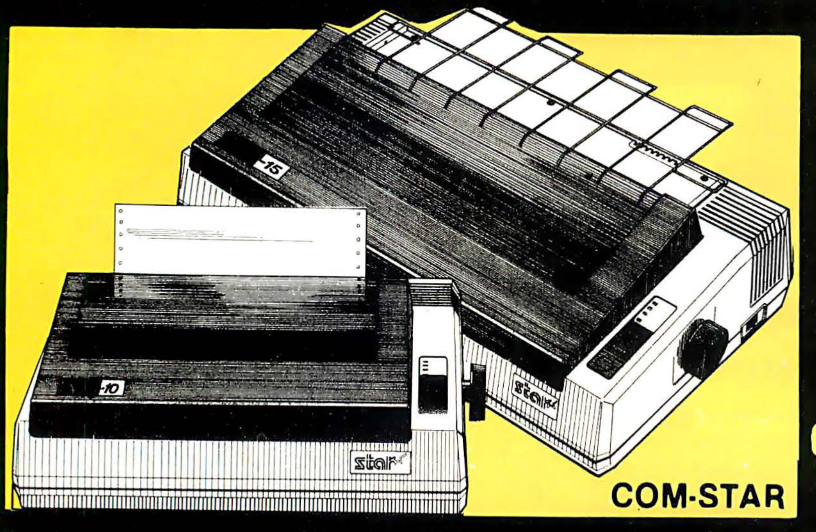
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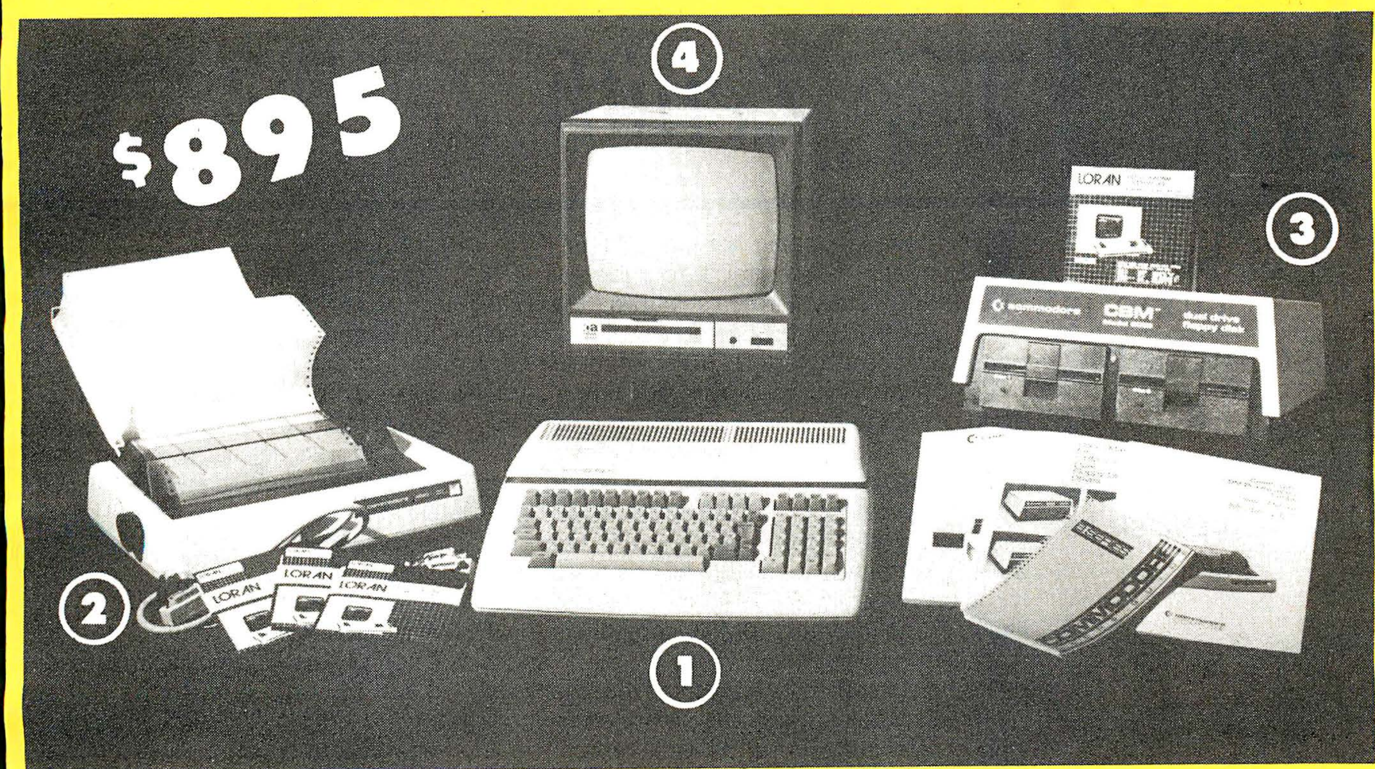
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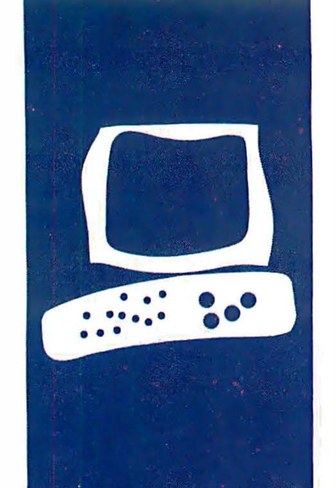
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The Zenith Z-150 PC

This IBM PC clone is also available in kit form

BY WAYNE RASH JR.

If you're shopping for an IBM PC-compatible computer, take a look at Zenith's entry into this market, the Z-150. Zenith has produced an almost perfect clone at a very reasonable price.

A Z-150 with two 360K-byte disk drives, an RS-232C serial port, a Centronics-type parallel port, and 320K bytes of RAM (random-access read/write memory) retails for $2799 (see photo 1). And it runs at the same clock rate, too. Electronically, the Z-150 is as identical to the IBM PC as it legally can be. Physically, the Z-150 is smaller and lighter than most other IBM PC-compatible machines.

The benchmark tests I ran show that the Z-150 essentially duplicates the performance of an IBM PC in all areas except those involving disk access. I suspect that the half-height disk drives were responsible for the differences in this area. See the "At a Glance" page for the benchmark times.

When you turn on the Z-150, you will notice that it doesn't have a long memory test like the IBM PC has. The Zenith does test its memory, but the operation takes place quickly, so you're up and running soon after you power up.

Another difference between the Z-150 and the IBM PC will present itself if you don't put a disk in the Z-150's drive when you power up the system. The Z-150 does not run BASIC in ROM (read-only memory); like other compatibles, it uses a disk-based version of BASIC.

If you look inside the Z-150 you will see that there is no motherboard. The Z-150 uses a backplane to support its IBM bus; all of the other cards, including the central processor, are plugged into the backplane. This arrangement is much more compact than that of the IBM PC.

HARDWARE

The Z-150 uses half-height disk drives. In the floppy-disk version, the two drives are stacked one above the other, with drive A on top. The hard-disk version has the floppy disk on top and the hard disk below.

The drives supplied with the Z-150 are manufactured by Mitsubishi and operate somewhat differently from other 5¼-inch disk drives. In fact, if you have used 8-inch drives, you will probably feel a sense of déjà vu when you first use the Mitsubishi drives. You insert the disks against spring tension until they click into place and then you close the latch. You can remove the disks by pressing a bar opposite the latch. When the disk-drive door opens, the disk pops out about an inch, just like with 8-inch drives.

The Mitsubishi drives operate quietly, but you will notice a clicking sound when you select them. In normal use they perform flawlessly.

It's easy to remove the Z-150's metal cover. When you take the cover off, you will notice that the compact switching-power supply is located behind the disk drives. The rest of the interior is for circuit boards. The power supply provides 168 watts, so you should be able to run the computer with every slot filled.

The backplane containing eight IBM PC XT-compatible expansion slots is to the left of the power supply (assuming you're standing in front of the computer). On a floppy-disk-based Z-150 four of these slots will be filled with the disk controller, video card, central-processor card, and a memory card containing 320K bytes of RAM. If you have a hard-disk Z-150, the last slot will hold the drive controller.

The backplane has five LEDs (light-emitting diodes) that provide diagnostic information. As the computer is powered up, each of these LEDs comes on; if the system fails to boot, you can tell at a glance where the failure took place.

Each of the Z-150's cards has more than one function. The central-processor card also contains the audio amplifier and generator for the computer's speaker and the connections for the keyboard. The speaker and a green LED pilot light are attached to the central-processor card. The

Wayne Rash Jr. is a member of the professional staff of American Management Systems Inc. of Rosslyn, Virginia. He consults with the federal government on microcomputers.

video board provides signals for both NTSC (National Television System Committee) composite and RGB (red-green-blue) color monitors. It is functionally compatible with the color-graphics card on the IBM PC. The disk-controller card operates the floppy disks that are built into the computer and has a connector that will let you attach two more disks externally. In addition, the RS-232C serial port is on this card. The memory card contains 320K bytes of RAM and the parallel printer port. When you get a Z-150, it comes complete, and there are still four expansion slots free.

If you choose to use the Z-150 with a monochrome monitor, colors will be represented by eight shades of gray. The video board offers either high resolution of 640 by 200 pixels or medium resolution of 320 by 200 pixels. Bit-mapped graphics are supported, and text resolution is either 80 or 40 characters by 25 lines.

The Z-150 has an Intel 8088 microprocessor operating at 4.77 MHz. It also has a socket for the Intel 8087 math coprocessor. The central-processor card plugs into the expansion bus just like all the other cards. This means that you can remove the central-processor card to repair the machine or to change switch settings. The central-processor card is longer than the other cards, so you have to bend it to get it out of the chassis. The board appears to be fairly tough. Despite the fact that I repeatedly removed and replaced cards, I never managed to break the board.

Getting Started

To begin using the system, turn on the computer (the switch is on the right rear of the cabinet) and the monitor. After the short memory test, the system will boot. You can disable the automatic boot feature, just as you can on Zenith's other computers. If you prefer, you can override the boot by pressing the Control, Alternate, and Insert keys at the same time to enter the monitor.

The Z-150 monitor ROM has an extensive set of diagnostic tools for the technically inclined user. As the monitor starts up, you are told how much memory is available and that you may enter a question mark for help. This request will give you an extensive menu of options to choose from, including everything from a full diagnostic test to a color-bar display. Other options allow extensive memory manipulation, program execution, tracing and disassembly, and performing input and output to, or from, any port. You can also choose various text and graphics modes and pick a fast hardware scrolling mode or smooth scrolling for graphics. At this point you also tell the

(continued)



Photo 1: A Z-150 *with two* 360K-*byte disk drives.*

system to emulate the Zenith Z-100's video if the Z-319 circuit board is present.

THE KEYBOARD

One of the most persistent complaints about the IBM PC concerns its nonstandard keyboard. Touch-typists find the odd locations of the Shift and Return keys frustrating. Had IBM used a keyboard similar to the Z-150's (as it did in the IBM PC AT), this criticism would have been avoided. The Z-150 has the same keyboard layout as the IBM Selectric typewriter, although obviously some keys have been added (see photo 2). The feel of the keys is similar to that of the excellent Z-100 keyboard.

The Caps Lock and Num Lock keys have LEDs embedded in them so you can tell when they are toggled. These LEDs work fine when you actuate the key yourself, but they give no indication if they are toggled by software. There is an Enter key to the right of the numeric keypad, which makes using the numeric keypad a little easier than using the IBM PC's numeric keypad.

Other than the placement of the Shift, Return, and Enter keys, the detachable Z-150 keyboard closely resembles that of the IBM PC. The function keys are in the same place, and the bezel surrounding the keyboard is the same shape, so your templates will fit fine. (Incidentally, the Z-100's keyboard is plug-compatible with the IBM unit, and it is available separately.)

The Zenith keyboard has some of the same cryptic symbols on it as the IBM PC keyboard. Fortunately, the symbols are supplemented by words explaining their function. This can be helpful to people who use computers infrequently.

The keyboard can generate the full ASCII character set, as well as block graphics and some international, mathematical, and scientific symbols. There are some 256 characters available. An electronically generated key click is also available.

USING THE Z-150

The Z-150 operates unobtrusively. It does not have roaring fans or grinding disk drives, and the keyboard is quiet. The only noise you will notice it making is an occasional software-generated "beep."

When using the Z-150 there are no troublesome conversions or alternate installations to make. You don't even have to worry about which operating system is on the disk you are trying to boot. IBM's PC-DOS runs fine on the Z-150, and the Z-150's MS-DOS runs fine on the IBM. However, you will run into a problem if you swap operating systems and then try to use BASIC. BASICA on the IBM requires ROM BASIC, but the Z-150's BASIC is on disk.

I do have one complaint about the monitor that came with the Z-150 I reviewed. Zenith's ZVM-122 green monochrome monitor does not have nonglare glass so reflections were always a problem. Zenith's other monitors do have nonglare screens, and I think you will find it worth the slightly higher price to buy one of those. Incidentally, almost any monitor (except the IBM green monitor) will work with the Z-150 because it has both composite-video and RGB output jacks.



Photo 2: *The Z-150's 84-key keyboard.*

SOFTWARE

Unlike some other IBM PC-compatible computers, the Z-150 does not come bundled with a lot of software. Even BASIC is optional. In fact, the only software it does come with is Microsoft's MS-DOS, but both versions 1.25 and 2.11 are included, so you should be able to run almost any program you can find for the IBM PC on the Z-150. Also included with the Z-150 is an excellent demonstration disk that introduces new users to the machine.

Because a great many IBM programs depend on your system having BASIC, you will probably have to buy Microsoft's GW-BASIC ($100 list price). GW-BASIC is an almost perfect emulation of the BASIC used by the IBM PC. I could not find any software designed for IBM's BASICA that did not run under GW-BASIC.

DOS UTILITIES

Every Z-150's MS-DOS comes with all of the standard MS-DOS files plus several added by Zenith to make life easier for the user. In some cases these programs are similar to ones you would get with PC-DOS.

One of these added utility programs, Configur, has been a Heath/Zenith standard since the company first started using CP/M. Although the content of this utility has changed ac-

(continued)

AT A GLANCE

Name
Zenith Data Systems Z-150

Manufacturer
Zenith Data Systems
1000 Milwaukee Ave.
Glenview, IL 60025
(312) 391-8744

Dimensions
Central processor: 17 by 16 by 6 inches
Keyboard: 8 by 18½ by 1¾ inches
Weight: 41 pounds

Components
Processor: 4.77-MHz 8088
Memory: 320K bytes of RAM
Display: 80- by 25-character line display includes graphics and smooth scrolling capability; graphics resolution is 320 by 200 pixels with four colors or 640 by 200 with two colors
Keyboard: IBM PC-type
Mass storage: two 360K-byte half-height double-sided double-density floppy-disk drives

Communications
One parallel port, one RS-232C serial port

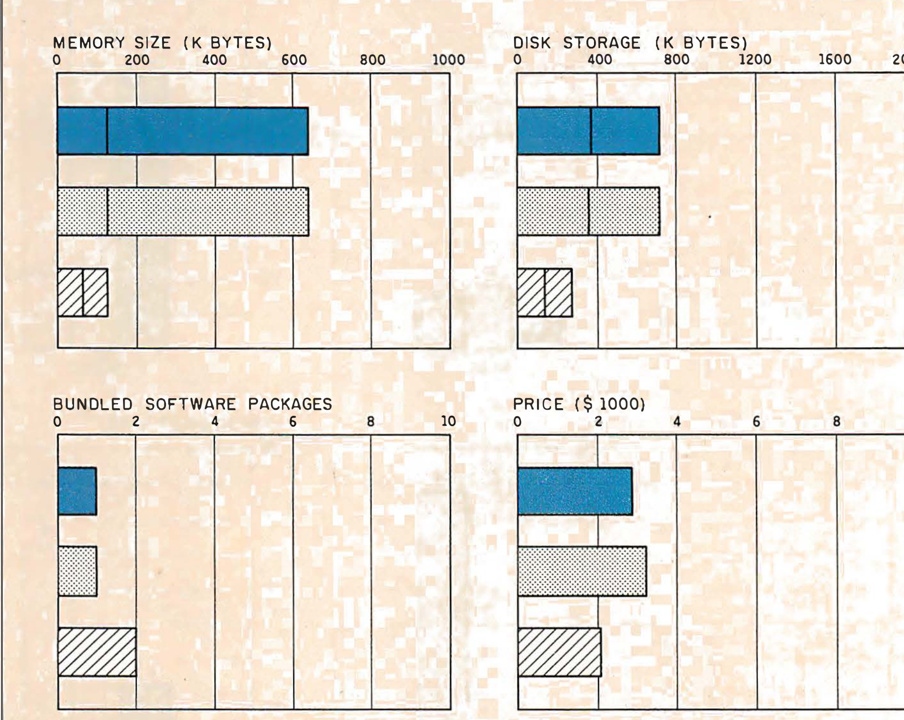
Software
MS-DOS versions 2.11 and 1.25

Options
10.6-megabyte hard disk: $1499; 8087 coprocessor: $225; Z-319 high-resolution video board: $499; ZVM-133 RGB color monitor: $599; GW-BASIC: $100

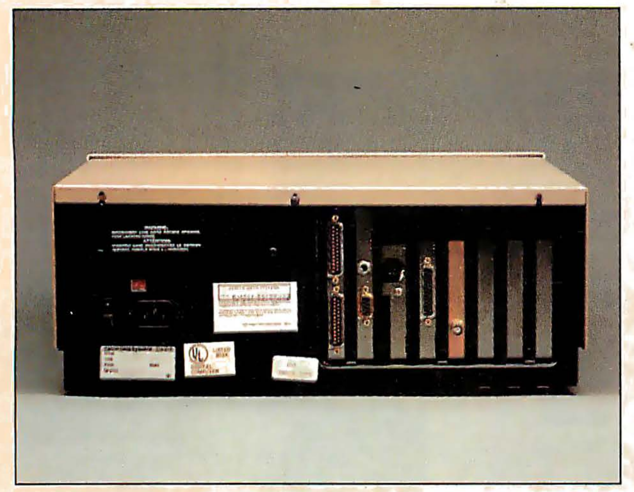
Documentation
Z-100 PC operations manual, includes user's guide and hardware manual

Price
$2799
With monochome monitor and GW-BASIC: $3040

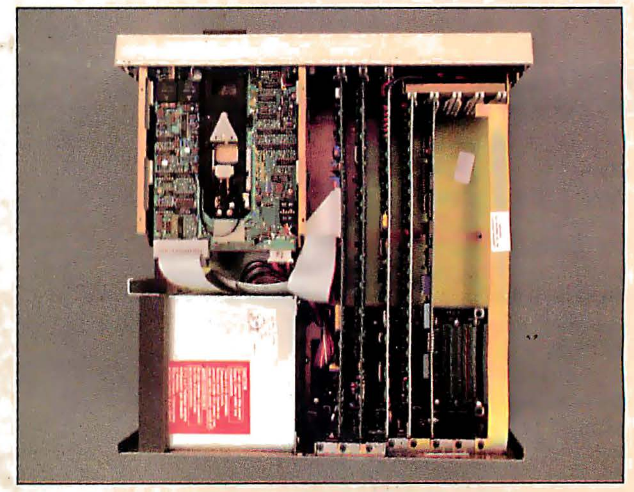




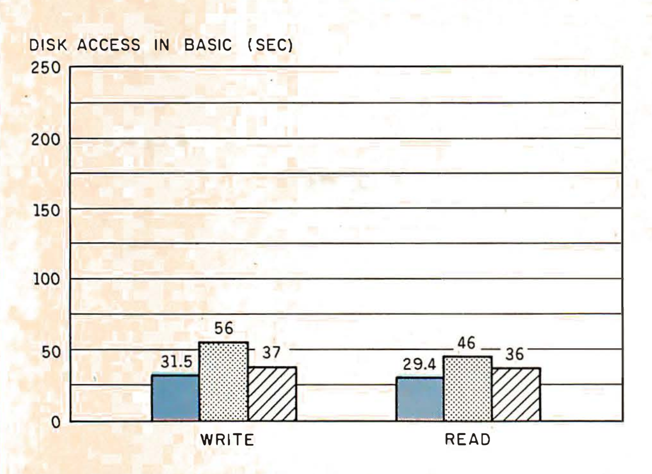
The Memory Size graph shows the standard and optional memory available for the computers under comparison. The graph of Disk Storage capacity shows the highest capacity of one and two floppy-disk drives for each system. The Bundled Software Packages graph shows the number of software packages included with each system. The Price graph shows the list price of a system with two high-capacity floppy-disk drives; a monochrome monitor; graphics and color-display capability; a printer port and a serial port; 256K bytes of memory (64K for 8-bit systems); the standard operating system for each system; and the standard BASIC interpreter for each system.

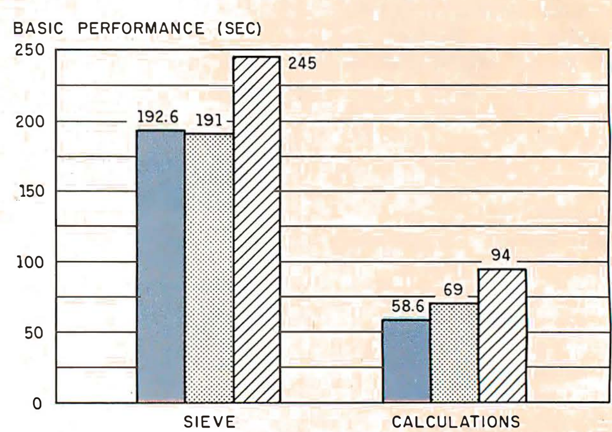


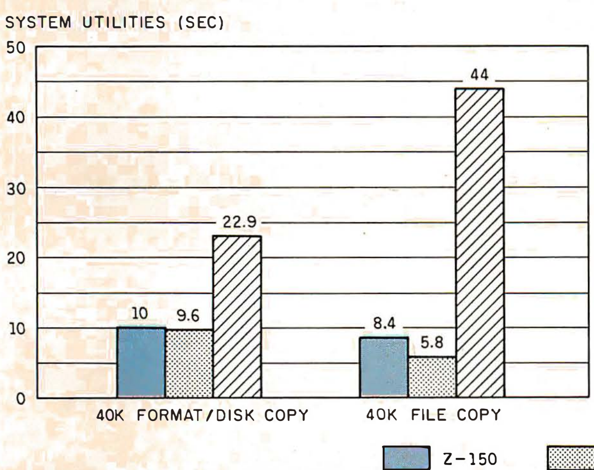
The rear of the Z-150 computer looks almost the same as the rear of an IBM PC.

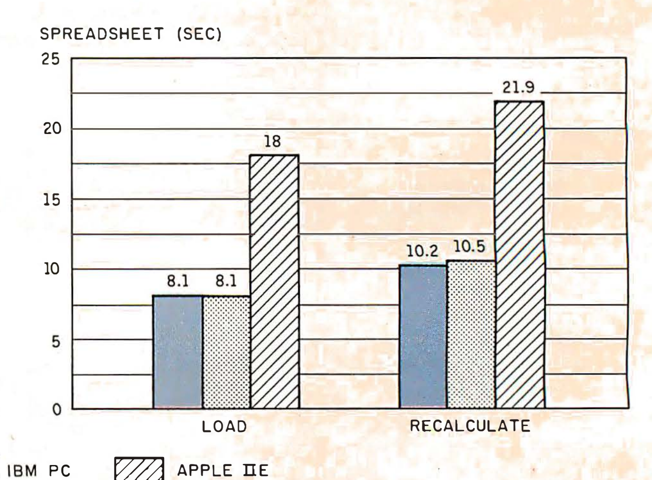


The inside of the Z-150. Note that there is no motherboard in this computer.









Z-150 IBM PC APPLE IIE

The graphs for Disk Access in BASIC show how long it takes to write a 64K-byte sequential text file to a blank floppy disk and how long it takes to read this file. (For the program listings see June BYTE, page 327 and October, page 33.) The Sieve graph shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The Calculations graph shows how long it takes to do 10,000 multiplication and division operations using single-precision numbers. The System Utilities graphs show how long it took to format and copy a disk (adjusted time for 40K bytes of disk data) and the Spreadsheet graphs show how long the computers took to load and recalculate a 25- by 25-cell spreadsheet where each cell equals 1.001 times the cell to its left. The spreadsheet program used was Microsoft Multiplan.

The tests for the Apple IIe were done with the ProDOS operating system. The Apple IIe Multiplan test was done with DOS 3.3. The IBM PC was tested with PC-DOS 2.0.

cording to the computer for which it is designed, its general purpose has always been to match the operating system to the peripherals.

As the state of the art in microcomputing has progressed, the complexity of the Configur program has decreased. To use this program with the Z-150, the only thing you have to do is tell the operating system about the communications ports. Normally, the operating system assumes that the Z-150 is using a parallel printer and that the first serial port, COM1, is being used for a modem connection. You can change this if you have a serial printer by mapping the parallel output to either one of the serial ports. You can also reconfigure the serial ports as necessary. To operate the Configur program you use a menu containing most common choices. You can even set the system up for many of the most common serial printers and modems by using the menu. If your printer is not listed, you can assign almost any value to the serial ports, and the computer will prompt you for the information it needs.

Another well-known Zenith utility that was carried over from the Z-100 is RDCPM. This program can read a CP/M disk directory and transfer files from CP/M disks to MS-DOS disks. According to the Z-150's manual, this utility can read CP/M-86 disks from the IBM PC and the Z-100, and CP/M disks from the Z-100. This utility also lets the Z-150 read soft-sectored Heath CP/M disks and Radio Shack Model 4 CP/M+ disks. If you already have a machine that can write the Z-100 CP/M disk format (such as a Kaypro with Uniform), you will be able to trade data between machines at will. The RDCPM utility can make a great deal of difference when the time comes to buy an additional computer.

The Cipher utility program allows you to encrypt and decrypt disk files. This utility is handy when users of hard-disk-equipped machines must let a number of other people use them.

The FC utility is the same as the Comp utility that comes with PC-DOS. Both of these utility programs let you compare disk files to see if they are identical, but the FC program is more flexible. It lets you set software switches to force a binary comparison or to ignore case when comparing the files.

The PSC utility is an expanded version of PC-DOS's Graphics utility. The PSC program lets you print graphics screens on any one of six printers: IDS, MPI, Okidata, Epson MX-80, Printek 920, and Transtar 315. Once the Z-150 is in the graphics mode, you can print any graphics screen by pressing the Shift and Print Screen keys.

The Z-150's Search utility lets you search the main directory and all subdirectories for a particular file or for several files. The Search program will also display a graphic representation of the directory structure. This utility is somewhat similar to the PC-DOS Tree utility, although it is more flexible and has more functions, such as the ability to find a specific file.

The Sort program allows you to sort the contents of a file, usually to another file or output device. You can also sort the disk directory by sending the directory listing to Sort and then to the screen. This is helpful when you use MS-DOS's "pipes." You can pipe the output from one file or device into Sort. The output from Sort can go to a device such as the screen or a printer or it can go to yet another file.

The Apply utility also makes good use of the MS-DOS pipes. This program can be used to provide a list of files upon which a certain program is to act. One obvious use for this is to provide a list of files to be backed up and have them copied to another disk one at a time.

Documentation

Zenith and Heath have long been known for the quantity and the quality of their documentation. Although there is not as much documentation for the Z-150 system as there is for the Z-100, the quality remains high.

The Z-150's 50-page user's guide explains the basic operation of the system and shows you how to hook up your peripherals. The explanations and illustrations are clear. The manual tells you how to keep the case clean and who to call if you need to get your computer fixed. This book explains a few technical terms, but for the most part it is written for the beginning user.

Experienced users will find the hardware manual more useful. For example, this manual tells you the proper settings for the DIP (dual-inline package) switches when you expand memory. Most of the features of the Z-150 are described in some detail, although the explanations are not as thorough as they might have been in earlier Zenith manuals.

The hardware manual is useful as a sort of quick-reference guide. You will find short explanations of MS-DOS commands, the use of the monitor ROM, and the diagnostic LEDs. This manual also contains charts and lists of specifications. Finding what you need is not difficult because the index is excellent. The appendix contains a complete glossary, so even if you're new to computers, you will be able to understand the manual.

The hardware manual is written clearly and concisely. It includes drawings and diagrams that add a great deal to the explanations and make them understandable to most users. In fact, most users will probably never need any more of a hardware manual than this.

The End User Demonstration Disk is not listed as a part of the documentation, but it should be. It is one of the best computer orientations I have encountered. For example, the hardware portion of the demonstration takes you on a tour through the parts of the computer, drawing each one on the screen and telling you about it. It also highlights the drawings where necessary to aid the discussion. You start the demonstration program using a batch file, so a novice user need not even know how to get a program up and running.

The orientation program is divided into five parts; to select one you choose it from a menu. I drafted a novice user to try out this program, and her response was positive. With

(continued)

it, she was able to learn enough about the Z-150 to begin using it immediately.

Users who like detailed technical documentation will love the MS-DOS manual. It is complete, detailed, and large. Fortunately, it is also organized so that less experienced users will be able to find out what they need to know without being bogged down. This usually is done by labeling parts of each section as "Basic" or "Advanced" concepts. Readers are also shown what the screens will look like when the program is run, and each of the possible responses is explained.

SERVICE AND SUPPORT

Zenith has a number of authorized repair facilities around the country and overseas. You can also have your Zenith computer repaired at a Heathkit store if one is nearby. Although you have to bring your computer to the Heathkit store to have it fixed, the other repair stations will fix your computer at your location. Zenith is the only manufacturer I know of that will do on-site warranty service.

I never needed service for the Z-150,

BUILDING THE H-150 COMPUTER KIT

BY HENRY B. COHEN

Assembling the Heathkit H-150 computer kit is fairly straightforward. The manual takes you smoothly through the first steps (building and testing three printed-circuit boards) but leaves you searching for the final assembly process. You have to look in three different places to find all the directions. It took me about 22 hours to build the computer to factory quality. A Heathkit store manager told me that the average time to assemble the H-150 was 20 hours. Heath even includes a practice soldering course so that novices won't make mistakes soldering the H-150 together.

As with any complex electronics kit, and especially one subject to upgrades, addenda abound. There were roughly 20 pages of corrections to be added into the manual. I found it helpful to mark the manual wherever the addenda sheets called for a change and reference the addenda sheets as necessary.

To save time, place the parts in separate piles or cups before you begin to stuff and solder a board. Then sort the different-sized chip sockets into groups. I think it's a waste of time to check the parts against the parts list—if you're missing anything you'll find out soon enough as work progresses.

Even through the manual illustrates the parts, it's sometimes hard to find them. When this happens, it's best to work around the part you can't identify; eventually it will show up.

In its manual, Heath recommends certain tools you should have to complete the project. The list is helpful, but you'll need other tools as well. A voltmeter is essential for calibrating the disk-controller circuit board and an ohmmeter is necessary for resistance checks of all boards. You'll need either a VOM (volt-ohmmeter), digital voltmeter, or multitester, which are similar products. It is also preferable to use a temperature-controlled soldering station and an automatic wire stripper; a desoldering station would be handy for those prone to hurried work and errors.

Heath provides much more solder than you actually need. This is a good idea but it may invite oversoldering. Use the minimum amount of solder necessary to completely solder a part to the board. There should be no open areas around a connection and each connection should be well rounded and shiny. Since the board has a tendency to swallow solder through capillary action, don't be surprised if a joint is flat. With a heat-controlled iron you can solder first for integrity, and then go back at a lower heat to solder for appearance.

To ensure that all sockets lie flat use adhesive tape to hold them to the board, then solder the first pin of the first row and the last pin of the second row. Remove the tape and solder all the pins.

Solder flux—the shiny, dirty residue you won't find on factory boards—can be removed from a completed board with Carbona or a commercial flux remover and a toothbrush. It is important to remove the residue because the board will be electronically better, it will look professionally constructed, and by removing the residue you may reveal a hidden imperfect joint.

On the factory-built disk-controller board, the two controls that set critical voltages are topped with a dot of melted wax. You can duplicate their appearance by melting a crayon over the adjustment screws after you've finished calibration.

To facilitate the installation of all chips, the pins must lie perpendicular to the bodies. Carefully bend them as shown in the manual. None will fit smoothly without this adjustment.

Why *build* a Heathkit when you can buy a *factory-built* version (under the Zenith Data Systems name) from a discount dealer for the same money?

Because with the kit you get a diagnostics program on disk and a service manual that would cost about $200 if ordered separately.

If you build your own it will also be easier for you to upgrade your kit. You know how it's put together and have learned how to configure or reconfigure it. If the high cost of Heath-supplied memory leaves you cold, you can buy the same chips from a mail-order house at a fraction of the cost. It couldn't be quicker or easier.

For users who need to run specific programs this might not be important, but for those of us interested in computing as a tool, a hobby, or an avocation, these "fringe" benefits are invaluable. My machine works as well as any from the Zenith plant and my boards are every bit as good as those factory-assembled.

Henry B. Cohen (240 East 35th St., New York, NY 10016) is technical editor of Electronic Games *and Home Electronics editor of* Mechanics Illustrated.

although I once had a Z-100 repaired. That time the repair was completed within a few hours after my call. I did call Zenith's technical service department about the Z-150 shortly after I received it. I wanted to add more memory, and at that time the hardware manual was not available. The service department was courteous and helpful and they gave me precisely the information I needed over the telephone.

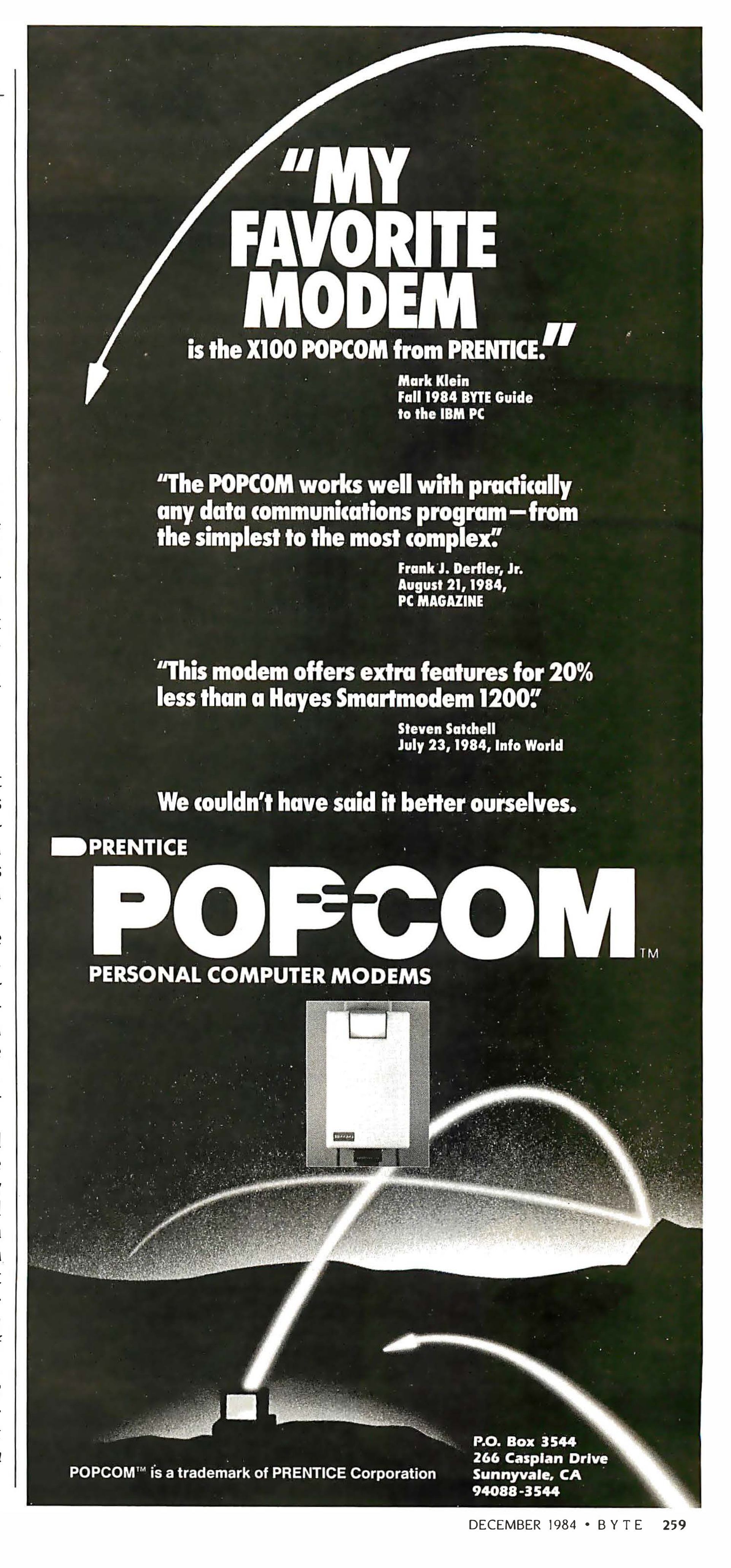
Software support for the Z-150 seemed to be good also, although I didn't need much help in that area. If the software technicians don't know the answer to your question, as sometimes happens, they will find out the answer and call you back. The biggest problem in getting help from the company is getting them on the phone. They don't have a toll-free number and the lines are frequently busy.

CONCLUSIONS

The Zenith Z-150 PC could be the best deal around for someone who needs an IBM PC-compatible desktop computer. It costs a great deal less than a similarly configured IBM PC, it takes up less space, and it has more room for expansion.

The problems I encountered while reviewing this machine were minimal. One serial port could not be configured when I first received the system but that was corrected through a ROM upgrade. The hardware manual was not available at first, which made expansion of the machine difficult.

The Z-150 is a sturdy, well-designed machine that should provide reliable service. It is backed by a company with a solid reputation for quality and service. About the only way to get a better deal would be to buy the Heath version of the computer and build it yourself. [*Editor's note: In fact, the kit version is more expensive, because you can buy an assembled Z-150 with 360K bytes of memory for about $2000 from some dealers, whereas a kit with all the features of the Z-150 costs about $2100. As to why anyone would want to build the kit, see the text box "Building the H-150 Computer Kit," on page 258.*] ■




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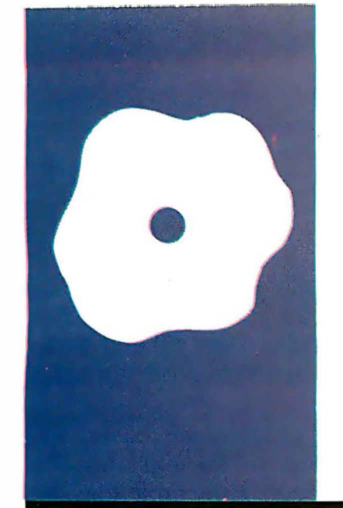
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S·O·F·T·W·A·R·E R·E·V·I·E·W

TK!*Solver*

A tool for scientists and engineers

BY ALAN R. MILLER

An application program for solving general mathematical expressions, TK!Solver is most useful to scientists and engineers. It is available for the IBM Personal Computer (PC), PC-compatibles, and the Apple IIe. I used the IBM PC-DOS version for this review. I also briefly tried a CP/M-86 version running on a Digital Equipment Corporation (DEC) Rainbow. The list price of TK!Solver is $400, but prices as low as $300 appear in advertisements.

Programming languages such as BASIC and Pascal are useful for performing a sequence of operations and printing out the results. The user's source program includes branching and looping instructions to control the course of the operations. The program seems to grow larger and larger with time. Spreadsheets, on the other hand, are useful for analyzing tables of data. Frequently, time is one coordinate of the table. Although TK!Solver shares some features of each, it is neither a programming language nor a spreadsheet. TK!Solver emphasizes the solution of equations written in their usual form rather than the manipulation of a matrix of data cells.

To use TK!Solver you type one or more mathematical equations and define the variables used. But you do not write a computer program. Many commands begin with the slash (/) symbol, similar to spreadsheet programs like VisiCalc and SuperCalc. Then a list of valid secondary commands appears at the top of the screen.

In some ways, TK!Solver is like the APL programming language (see references 1 and 2). The first similarity is that, in both, scalars and vectors are assigned symbolic names that are used in expressions. Secondly, both have a direct mode and an equation-solving mode. However, TK!Solver expressions are written in the natural style of mathematics rather than in the form used with languages such as BASIC and Pascal. For example, the expression EXP(X) = 4 * X is in a form that can be solved by TK!Solver. However, the equation can also be written as 4 * X = EXP(X) or EXP(X) − 4 * X = 0, and TK!Solver can find the solution. By comparison, the expression would have to appear as Y = EXP(X) − 4 * X to be used in a BASIC program.

GETTING STARTED

TK!Solver appears to be a very complex program. Its voluminous manual is difficult to follow. A companion text, *The TK!Solver Book* (see reference 3), provides much additional information, but it is a bit formidable. Fortunately, TK!Solver is really very easy to use when taken little by little.

The TK!Solver disk for the IBM PC version cannot be duplicated, and the main program, TK.COM, cannot be copied to another disk. However, you can speed up the operation by copying the auxiliary programs to a rigid disk or a semiconductor disk. But you first have to boot DOS (disk operating system).

You next place your regular system disk in the left drive (drive A) and turn on the computer. If you have a rigid disk, make that your default drive (drive C). Alternatively, set up a semiconductor RAM (random-access read/write memory) disk in memory for drive C if you have the software and at least 250K bytes of memory. You have to allot 125K bytes to this RAM disk.

After you establish a small print buffer in memory (if you have the software), printouts of various TK!Solver screens can be rapidly obtained. Place a backup disk in the right drive (drive B) so you can save the models you create.

After the computer has started up, you replace the system disk in drive A with one of the two duplicate TK!Solver disks. Then you copy the programs TK.OVL and TK.HLP to your working drive. This is drive C if you use a semiconductor disk or a hard disk, otherwise use drive B. Make your working drive (B or C, depending on your hardware configuration) the default disk. The command A:TK executes the main program

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← Circle 71 on inquiry card.

AT A GLANCE

Name
TK!Solver

Type
Application program for solving mathematical equations

Manufacturer
Software Arts Inc.
27 Mica Lane
Wellesley, MA 02181

Computer
IBM PC and compatibles with PC-DOS, 256K RAM; DEC Rainbow with CP/M-86, 512K RAM; Apple IIe

Minimum Hardware and Operating System
One disk drive, 96K bytes of RAM, PC-DOS 1.1 or 2 or CP/M-86

Format
5¼-inch floppy disk (two identical copies)

Documentation
240-page manual; 16-page reference card; eight program models

Price
$400

Audience
Scientists and engineers

from drive A. After TK!Solver starts up, you can remove the original TK!Solver disk and replace it with the system disk.

When TK!Solver starts up, it displays a title page with the version number and copyright notice. Press the Enter key to begin. There are 13 different tables known as sheets and subsheets; however, only one or two sheets are shown at any one time.

TK!Solver then displays two sheets—the Variable sheet on the top half of the screen and the Rule sheet at the bottom. You enter equations in the Rule sheet and define variables in the Variable sheet. You enter information at the location of the cursor, a reverse-video block on the screen. TK!Solver starts with the cursor in the Rule sheet because you begin a problem by entering equations there.

Before explaining how to solve an equation, let me discuss how to use the calculator mode.

CALCULATOR MODE

Values can be defined by entering numbers in the Variable sheet. However, it is also possible to enter a mathematical expression and let TK!Solver calculate the value. By this means you can directly determine the value of an expression. This is the calculator mode.

A TK!Solver number can have as many as 11 significant digits, and the exponent can be as large as 120. You can formulate expressions with the usual +, −, *, and / operators. The BASIC symbol ^ is used for exponentiation. However, the ** symbol of FORTRAN is not recognized. There are 17 built-in functions, including SQRT, SIN, ATAN, LN, and PI.

If you enter an expression into the Variable sheet that contains only numbers and operators, TK!Solver provides the answer immediately. For example, if you move the cursor in the input cell of the Variable sheet by pressing the semicolon key, type the three characters 1/3, and then press the Enter key or the down-arrow key, the answer replaces the original input. This is a convenient way to define constants needed for input. For example, you can enter the expression PI( )/180 when you need to convert from degrees to radians. (The TK!Solver function PI needs an empty pair of parentheses to indicate it is a function.)

DIRECT-SOLVER MODE

The direct-solver mode can solve an equation if two conditions are met: the unknown variable must not appear more than once in an equation, and the unknown may not appear as an argument to a function that does not have an inverse (for example, ABS, MOD, and INT). Thus, the equation X^2 − 2 = 0 can be solved directly since X appears only once. The positive root is generated. But the mathematically equivalent expression X*X − 2 = 0 is solved iteratively since X appears twice. Then either root can be found, depending on the initial guess.

TK!Solver variables are formed with all the letters of the alphabet, the digits 0 through 9, the underline, and the @, #, $, and % symbols. Names can be as long as 200 characters. Of course, a digit must not be used for the first character of a name.

While typing information, you can delete the previously entered character by pressing the Backspace key (but not the left cursor key). The entire line can be canceled by pressing the Break key. Each line is completed by pressing the Enter key or one of the four cursor keys.

After a line is completed, you can alter it with the edit command by moving the cursor to the desired field and typing /E. You can then move the cue, an underline character within the cursor, back and forth in the line by pressing the left and right cursor keys. Any character you type is inserted into the line at the position of the cue. Remaining characters are moved to the right. Pressing the Backspace key deletes the character to the cue's left.

THE VARIABLE SHEET

TK!Solver automatically adds the variables, such as Y and X, to the Variable sheet when you enter an equation into the Rule sheet. You move the cursor to the upper sheet by pressing the semicolon key. You use the cursor arrows to move the cursor to the input column of the line corresponding to a variable, such as X, in the Variable sheet.

The reverse-video block is where an entry goes. Suppose you define the value of X to be 3. You first press the 3 key, then press either the Enter key or one of the cursor keys. The Enter key leaves the cursor in the current cell, and the cursor key moves it in the desired direction.

After you define the value of X, TK!Solver can calculate the corresponding value of Y with the direct-solver command. Press the ! (exclama-

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tion point) key to initiate the calculation action and the value 8.0855369 appears in the output column of *Y*. The result looks like figure 1.

Another feature of TK!Solver appears in the upper right corner of the screen. The "47 /" is a memory indicator. It gives the amount of working memory in kilobytes. When there is less than one kilobyte of memory left, the indicator changes to "Low." When there is no more available memory, the indicator says "Out."

THE ITERATIVE-SOLVER MODE

As you have just seen, TK!Solver cannot directly solve for a variable that appears more than once or that appears in a function without an inverse. However, TK!Solver can find solutions by iteration if you enter initial approximations for the unknowns. You can see how this works by solving the previous equation for *X* instead of *Y*; that is, solve the equation 0 = EXP(*X*) − 4 * *X*.

If you move the cursor to the input cell for *Y* in the Variable sheet, press the zero key and then the down cursor, the output value for *Y* disappears as the new input value is accepted. After the cursor has moved to the *X*-input position, you can enter a first approximation for *X*. When you press the 3 key and then the left arrow, the cursor moves into the first, or "status," column (labeled St).

Pressing the letter G on your keyboard while the cursor is in the status column of *X* (without pressing the Enter key or a cursor key) tells TK!Solver that the input value is a guess. (Pressing G a second time tells the program you're not guessing anymore.) Hitting the ! key activates the iterative solver. Each successive approximation of *X* is displayed in the input cell replacing the original value. When the solution of 2.1532924 is found, the output cell for *X* displays it, and the input and status cells automatically clear.

SAVING AND LOADING EQUATIONS

Because TK!Solver works in main memory, you lose information when you turn off the computer. Therefore, you must save your equations on disk. When you give the command /SS (storage, save), TK!Solver asks for a filename. You provide only the primary name; the extension TK is added automatically. You have to include a specific drive name if you want to save the model somewhere other than the default drive. If a file of the same name already exists, the program asks for permission to delete it. When you press the right cursor key, the names of previously saved models appear successively at the top of the screen.

Loading a saved model is easy. First you have to clear the current work area with the /RAY (reset, all, yes) command and then give the command /SL (storage, load). If you do not remember the model name, you just repeatedly press the right cursor key and the name of each saved model appears at the top of the screen. Pressing Enter selects the displayed name; Break aborts the command.

WORKING WITH LISTS (VECTORS)

So far, each of the exemplar symbols I have mentioned has a single value. But sometimes it is more convenient to assign several values to a single symbol. The symbol then refers to a list of data called a vector or a one-dimensional array. For example, if you wanted to find the relationship between temperature and pressure for five different values, you set up a list for *T* and another for *P*. Or you could investigate the relationship as a mathematical function, *Y* = *f*(*X*), by generating a set of *X* values and calculating the corresponding *Y* values.

To create a list with TK!Solver, you have to clear the work area with the /RAY command and enter the equation *Y* = EXP(−*B* * *X*) * COS(*C* * *X*) into the Rule sheet. This is a damped sinusoidal curve that is one solution to a second-order differential equation. You move to the Variable sheet by pressing the semicolon key. The variables *Y*, *B*, *X*, and *C* are already there. Next, you move the cursor to the status column for *Y* (the far left side) and press the L (list) key. (This is the same column used for the G command in the previous problem.) Similarly, you move to the status column for *X* and press L again. The L symbol specifies that *X* and *Y* are list variables or vectors. After moving to the input column, you enter the values 0.3 for *B* and 4 for *C* and put a value of 0 in the input column of *X*. (This is apparently a bug. You shouldn't have to define a vector on the Variable sheet.) Figure 2 shows the result.

Values for the elements of a list are defined on the List subsheet. While the cursor is in the upper sheet, you give the =L command, which changes the upper part of the screen to the List sheet. Since you need the entire screen, you have to use the /W1 (one-window) command to temporarily remove the lower sheet. The vectors X and Y are already in the List sheet.

With the cursor on the row for vector X, you press the > key (known as the dive command) to change to the List subsheet for the variable *X*. Now enter 64 values for *X*. You could enter them one at a time, but it is much

(continued)

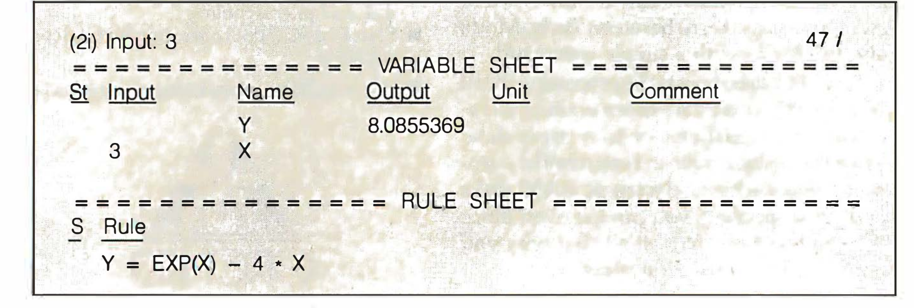
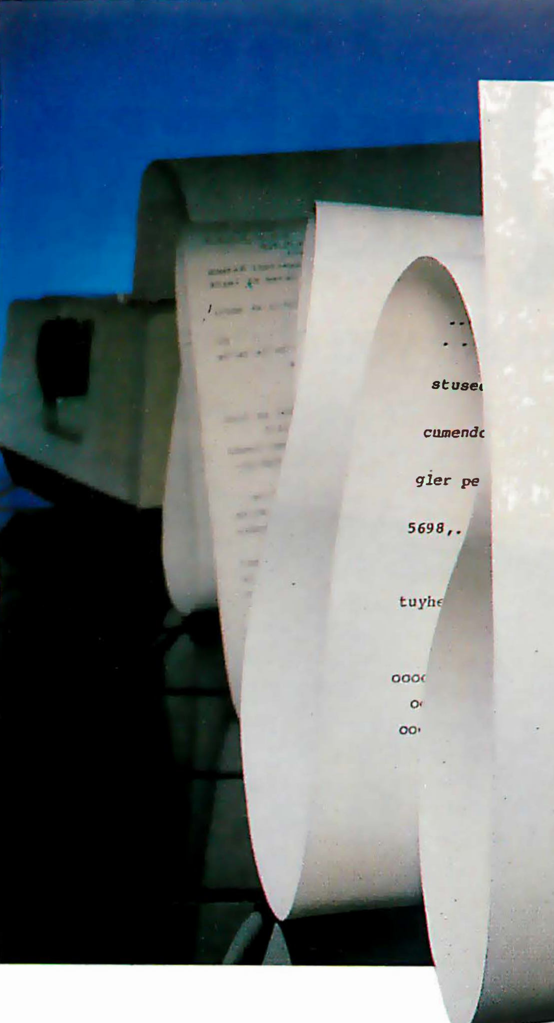


Figure 1: *Variable and Rule sheets for Y = EXP(X) − 4 * X.*



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easier if you enter the first and last values and let the program fill in the rest.

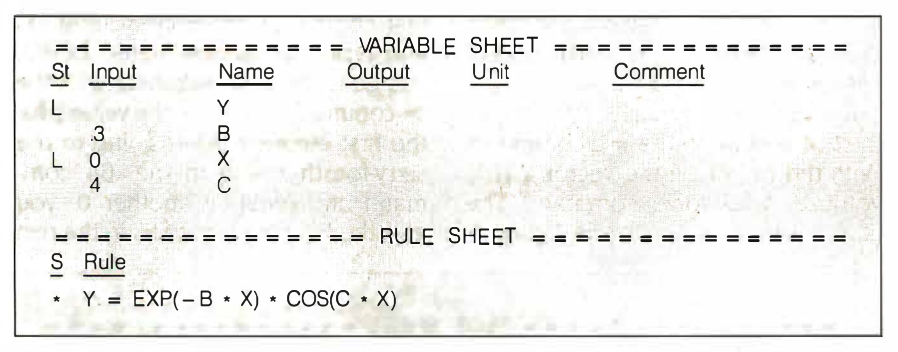
With the cursor on the first empty line below the word Value, you press the zero and Enter keys to define the first value of the variable *X*. Your value of 0 appears in the second column, and the index or element number 1 automatically appears in column 1. You cannot move the cursor into the first column of this sheet.

You move to row 64 by typing :64 and pressing the Enter key. Next, you type 2*PI( ) and press Enter. The value 6.283... appears in the value column and 64 appears in the element column. When you give the !Y command, the elements 2–63 are automatically filled in. The results would look like figure 3. Pressing the < key returns you to the List sheet.

The =V command returns the Variable sheet. You can also give the /WR command to restore the Rule sheet to the bottom half of the screen, but the cursor is then in this lower sheet.

If you are in the lower sheet, you

(continued)



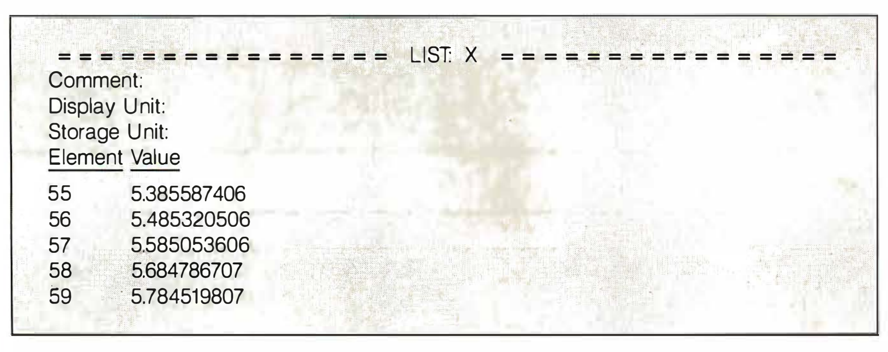
```
============== VARIABLE SHEET ==============
St  Input    Name    Output    Unit    Comment

L            Y
    .3       B
L   0        X
    4        C

=============== RULE SHEET ===============
S   Rule

*   Y = EXP(-B * X) * COS(C * X)
```

Figure 2: *Variable and Rule sheets for Y = EXP(–B * X) * COS(C * X).*



```
================ LIST: X ================
Comment:
Display Unit:
Storage Unit:
Element Value

55      5.385587406
56      5.485320506
57      5.585053606
58      5.684786707
59      5.784519807
```

Figure 3: *List subsheet for X.*

```
================ LIST: Y ================
Comment:
Display Unit:
Storage Unit:
Element Value

1       1
2       .8943140789
3       .6576799837
4       .3339767703
5       -.022118623
```

Figure 4: *List subsheet for Y after calculation.*

The simultaneous solution of a set of nonlinear equations can be difficult.

can move to the upper sheet by pressing the semicolon key. The list-action command begins computation. The equation is solved 64 times, once for each element of X. The current index number appears at the top of the screen during calculation so you can follow the progress. This process is slow; it takes about 1 second for each element. Perhaps an 8087 coprocessor would speed things up.

You can see the results by going to the List sheet with the = L command. With the cursor on the vector Y row, you use the > (dive) command. The results would appear as in figure 4. Typing = T sets up a Table sheet that lets you view both vectors at the same time.

The Plot Sheet

Because it may be useful to view data graphically, TK!Solver has a plotting routine. The plot can be displayed on the screen or on the printer, or it can be written to a disk file. (Of course, with the IBM PC you can print an exact duplicate of the screen at any time by pressing the Shift and PrtSc keys.) To obtain a plot, you have to return to the main List sheet with the < command. Next, you move to the first column at the bottom (after *Y*) and type the variable name ZERO. You go to the Zero subsheet with the > command and enter the value 0 for the first element. After going to the sixty-fourth row with the :64 command and entering another 0, you give the !Y command to fill in the rest of the array with zeros. This gives you a zero baseline for your plot.

```
=============== PLOT SHEET ===============
Screen or Printer:                 Screen
Title:                             Damped Sinusoidal
Display Scale ON:                  Yes
X-Axis:                            X
Y-Axis     Character

Y          *
ZERO       –
```

Figure 5: *The Plot sheet.*

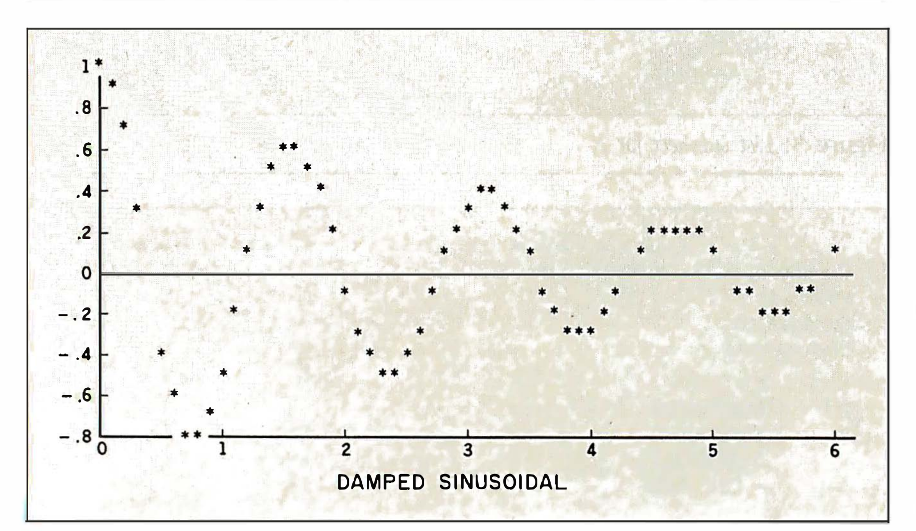


Figure 6: *Plot of Y = EXP(–B * X) * COS(C * X).*

After moving to the Plot sheet with the = P command, you can set up the plot details (see figure 5). The Plot itself is normally displayed only on the screen; however, if the letter P is placed in the upper right field of the Plot sheet, output also goes to the printer. Printer output can alternatively be sent to a disk file by entering the filename into the Global sheet. (You can get there with the = G command.) When you've moved to the second line of the Plot sheet, you can enter the title of the plot.

After moving the cursor to the fourth line and entering X as the independent variable, you move to the bottom left side and enter Y as the first dependent variable. If you move the cursor to the second column, TK!Solver shows that the default plot symbol is an asterisk. You can change it to anything else (see the bottom line of figure 5).

After you set up the Plot sheet, the ! command displays the plot on the screen (see figure 6). Pressing any key returns you to the Plot sheet. If you get an error message, you have to check the spelling and case of the variables in the Plot sheet to make sure they agree with the corresponding variables in the Rule sheet.

Simultaneous Equations

TK!Solver can solve several equations simultaneously. The simultaneous solution of a set of linear equations is easily accomplished by using a programming language such as FORTRAN (see reference 4). However, the simultaneous solution of a set of nonlinear equations can be very difficult.

TK!Solver solves all sets of simultaneous equations the same way (iteratively) whether they are linear or not. Consider the three linear equations

$$X + Y + Z = 6$$
$$X + Y - Z = 0$$
$$2 * X + Y - Z = 1$$

for which the solutions are $X=1$, $Y=2$, and $Z=3$, respectively. You can write

(continued)

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these three equations into the Rule sheet, but approximations must be given for two of the variables. With the cursor in the Variable sheet, you put 0 in the input fields of *X* and *Y* and enter the G symbol in the corresponding fields of the Status column to indicate guesses. After the ! command and several iterations, the solution appears.

Other Disks

The TK!Solver disk provides several models corresponding to examples described in the manual. In addition, you can buy disks containing models for specific subjects, including mechanical engineering, building design, introductory science, and financial management. These disks are called TK!SolverPacks. The mechanical engineering package has formulas for analysis of beams, heat transfer, fluid flow, moment of inertia, and Mohr's circle. A 100-page manual accompanies each disk.

Problems

There are no major problems with TK!Solver. The biggest annoyance is the distinction between uppercase and lowercase letters when entering symbols. However, commands can be given in either case. Computer languages usually treat upper- and lowercase letters the same. (Microsoft BASIC converts all letters to uppercase.) Therefore, when using TK!Solver be very careful to type a variable's name the same way every time. On the other hand, if you use both cases, both versions of the symbol appear in the list of variables. It should be easy to find this type of error.

TK!Solver is superb for solving almost any kind of equation. It can also be useful for solving a set of simultaneous nonlinear equations. However, simultaneous solution of linear equations is easier with a programming language such as FORTRAN, Pascal, BASIC, or APL. TK!Solver does not handle matrices, so matrix inversion and other matrix operations are not available. On the other hand, the built-in functions SUM and DOT provide limited vector operations. (SUM gives the sum of the elements, DOT gives the dot product of two vectors. Of course, the dot product of a vector with itself gives the sum of squares.) With these functions you can perform linear regression. But again, this is easier with a programming language.

TK!Solver has a function to determine if a variable has been defined and another to compare the magnitude of two variables, yet there are no logical variables. You do not write a computer program, and there are no branching operations anyway. You can contrive an APL-type program by combining several TK!Solver functions. But the resulting expression becomes as difficult to understand as a complicated APL expression.

Since TK!Solver does not use relational operators, expressions that arise in linear programming, such as $A + B + C < 100$, cannot be solved directly. However, you can convert such equations to regular linear equations for solution.

Summary

TK!Solver is a powerful tool, useful for scientists and engineers. No similar product exists. TK!Solver can rapidly solve one or more equations, including nonlinear equations. However, matrix operations are not included. Consequently, TK!Solver is a supplement, rather than a replacement, for programming languages such as BASIC and Pascal. On the other hand, it is not a spreadsheet because cells are not related to other cells. Currently, TK!Solver is available only for the IBM PC and PC-compatibles and for the Apple IIe (I've seen it advertised for the Macintosh). A CP/M-80 version would greatly increase the market. ■

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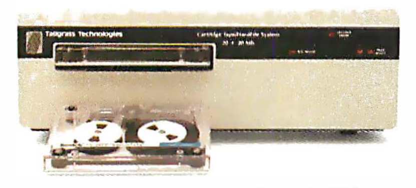
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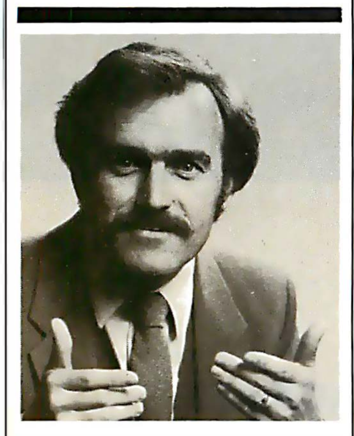
This is the first in a series of discussions with Rod Coleman, President of Stride Micro (formerly Sage Computer) on the 68000 multiuser market and its current environment.

Q: Why do you say that?

RC: "The technology to build a high performance multiuser system has been around for five years. And while some of the leaders in this industry have been pretending that micro multiuser didn't exist, we've been shipping complete systems for nearly three years. The benefits of multiuser are undeniable; it is more cost effective, and offers greater flexibility and utility. But until just recently, the marketing pressure to be compatible instead of being better, has blinded the industry."

Q: What do you mean?

RC: "Well, for example, the Motorola 68000 processor introduced 16/32-bit technology to the personal computer world a long time ago. It was fully capable of



"A surprising feature is compatibility. Everybody talks about it, but nobody does anything about it."

meeting high performance and multiuser design requirements in 1980. Instead of this trend taking off, most energy was spent promoting 8088/8086 products that were clearly inferior from a technical point of view. This phenomenon leads me to believe that they will soon rewrite the old proverb: 'Build a better mousetrap and the world will beat a path to your door,' but only if they can find the way through the marketing fog."

Q: Are things changing now?

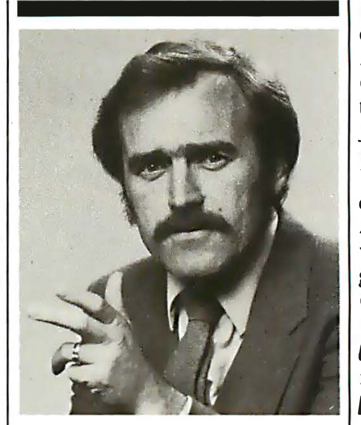
RC: "Yes and no. With the business world starting to take more and more interest in microcomputer solutions, the advantages of a solid multiuser system couldn't be kept hidden forever; companies like ours and a few others were beginning to make a dent. Instead of taking a fresh approach, some of the newest multiuser offerings will probably only give the technology an undeserved black eye! Multiuser is far more than the ability to plug in more terminals. It involves things like machine compatibility, fast processors, adequate memory, large storage capacities, backup features, networking, and operating system flexibility."

Q: Is this what makes the new Stride 400 Series different?

RC: "Exactly. That sounds self-serving, but it's true. Today a number of companies are introducing their first multiuser system. We've been building and shipping multiuser machines for almost three years. We know the pitfalls, we've fallen into some of them. But we have learned from our mistakes."

Q: Give me some examples.

RC: A hard disk is almost mandatory for any large multiuser installation. Yet, backing up a hard disk can be a nightmare if you only have floppies to work with. That's why we've added a tape backup option to all the larger Stride 400 Series machines. It's irresponsible for a manufacturer to market a multiuser system without such backup. Another good lesson was bus design. We started with one of our own designs, but learned that it's important not only to find a bus that is powerful, but also one that has good support and a strong future to serve tomorrow's needs. We



"The marketing pressure to be compatible instead of being better, has blinded the industry."

think the VMEbus is the only design that meets both criteria and thus have made it a standard feature of every Stride 400 Series machine."

Q: What are some of the other unique features of the 400 Series?

RC: "A surprising feature is compatibility. Everybody talks about it, but nobody does anything about it. Our systems are completely compatible with each other from the 420 model starting at $2900, through the 440, on to the powerful 460 which tops out near $60,000. Each system can talk to the others via the standard built-in local area network. Go ahead and compare this with others in the industry. You'll find their little machines don't talk to their big ones, or that the networking and multiuser are incompatible, or that they have different processors or operating systems, and so on."

Q: When you were still known as Sage Computer, you had a reputation for performance, is that still the case with the new Stride 400 Series?

RC: "Certainly, that's our calling card: 'Performance By Design.' Our new systems are actually faster; our standard processor is a 10 MHz 68000 running with no wait states. That gives us a 25% increase over the Sage models. And, we have a 12 MHz processor as an option. Let me add that speed isn't the only way to judge performance. I think it is also measured in our flexibility. We support a dozen different operating systems, not just one. And our systems service a wide variety of applications from the garage software developer to the corporate consumer running high volume business applications."

Q: Isn't that the same thing all manufacturers say in their ads?

RC: "Sure it is. But to use another over used-term, 'shop around'. We like to think of our systems as 'full service 68000 supermicrocomputers.' Take a look at everyone else's literature and then compare. When you examine cost, performance, flexibility, and utility, we don't think there's anyone else in the race. Maybe that's why we've shipped and installed more multiuser 68000 systems than anyone else."





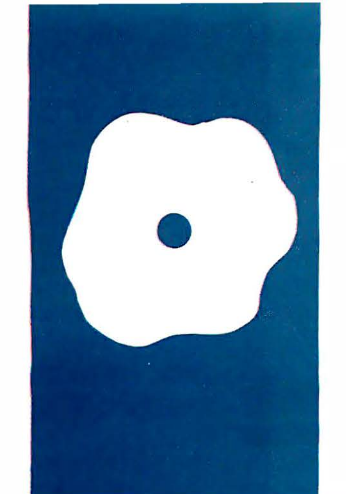
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S·O·F·T·W·A·R·E R·E·V·I·E·W

WordPerfect

Powerful capabilities —and some annoyances

BY RICARDO BIRMELE

Thousands of years ago, people put their thoughts down on clay tablets. It was inexpensive and permanent, and they never ran out of ink. However, they had to write quickly before the clay tablets had a chance to dry. Later they wrote on sheepskin parchment—better all around, except for the sheep. Now everyone had time to compose ideas and write them more clearly. However, mistakes were expensive; there were only so many sheep.

During the Middle Ages, people used feathers plucked from birds to write on paper made from wood and cotton. It was a time-consuming process and hard on the local bird population. Then the typewriter appeared. People could write clearly and quickly, fix mistakes easily, and not bother the local fauna. However, they were limited by paper size.

Modern authors have the word processor. Fixing mistakes is no more than a small inconvenience; the bottom edge of the paper no longer exists. In fact, word processors are such a good idea that everyone is trying to write one. So many exist now that you must choose the one that includes the features you find most convenient.

THE BASIC QUESTIONS

WordPerfect, a capable and very easy-to-use piece of software, was first conceived by Alan Ashton, a computer science professor at Brigham Young University, and Bruce Bastion, one of his graduate students. They received immediate feedback on the program by testing each new feature on the secretaries who would be using it in their jobs. When the IBM PC appeared, they decided to implement WordPerfect on that machine. Unlike most other word-processing programs (which were first written for 8-bit machines and then scaled up to a 16-bit microprocessor), WordPerfect was scaled down to the 16-bit machine and thus can use its capabilities fully.

The package runs on the IBM PC (and its clones), the Victor 9000, the DEC Rainbow 100, the Zenith Z-100, and the Tandy 2000.

WordPerfect is actually a collection of several closely integrated programs, including a bundled 30,000-word dictionary with room for 10,000 user-included words, and extensive mathematical and merge functions. It provides automatic text reformatting, automatic footnotes, proportional spacing, document encryption, and macro instructions. The package comes on two non-copy-protected disks: one contains the program and supporting files and the other contains the dictionary. A comprehensive, well-written tutorial/reference-style manual is also included.

Instead of extensive on-screen menus, WordPerfect provides a keyboard template and key stick-on labels for the various word-processing commands. It uses all the IBM's keys, some in combination with the Control, Alternate, and Shift keys.

This word processor requires a minimum of 128K bytes of memory, two double-sided disk drives, a color or monochrome display, MS/PC-DOS, and a printer.

It also uses a programming concept called virtual memory. This means that your document can be as large as your memory and the program can access any part of the document without your having to actively reload it. However, if you were writing a book you would want to break it into chapters. Scrolling from one end of a 100K-byte document to the other, even if it is in memory, can take a while.

THE SCREEN

When you first boot up WordPerfect by pressing WP at the A> prompt, you see an almost blank screen. In the bottom right corner are the obligatory line and column position indicators (column in this case called "Pos"), and two other bits of information.

"Doc" refers to WordPerfect's ability to edit two documents without going through a save/reload process—you can go from one

(continued)

Ricardo Birmele (714 Cherry St., Berrien Springs, MI 49103) is an independent computer consultant and technical writer. His other main interests are flying, nature, and his family.

document to another by pressing Alternate-F1 and answering the prompting menu with a "1". It takes about two seconds with a hard disk, somewhat longer with a floppy. You cannot quit WordPerfect if either of these documents is still open.

The other bit of information is "Pg", or page number. WordPerfect is a page-oriented word processor; the document appears to the machine to be a number of related documents, rather than one continuous piece of information. You can print any one of these related documents independently of the rest.

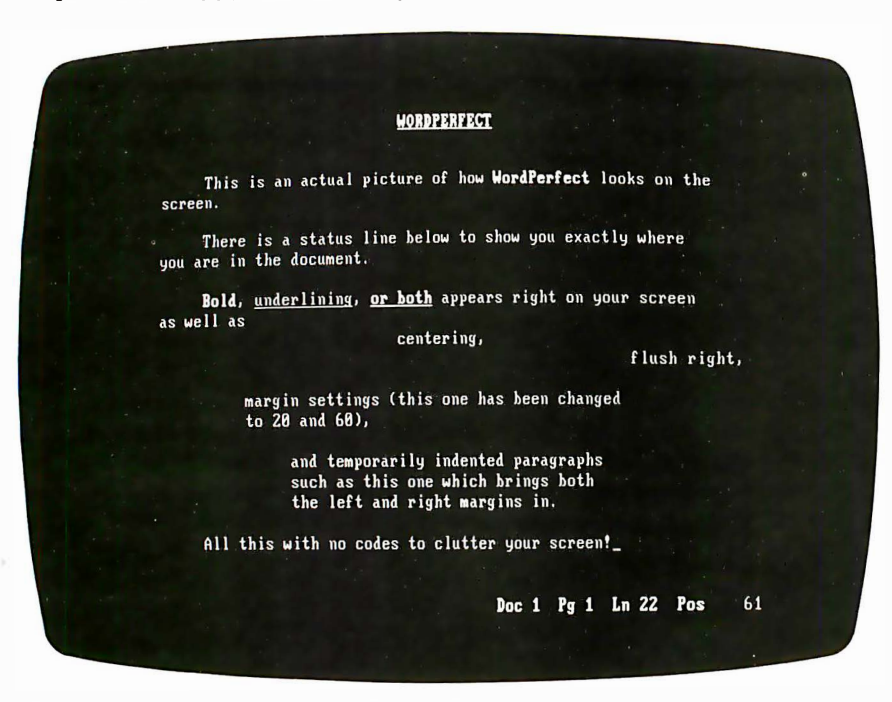


Photo 1: *An example of WordPerfect's "what you see is what you get" screen.*

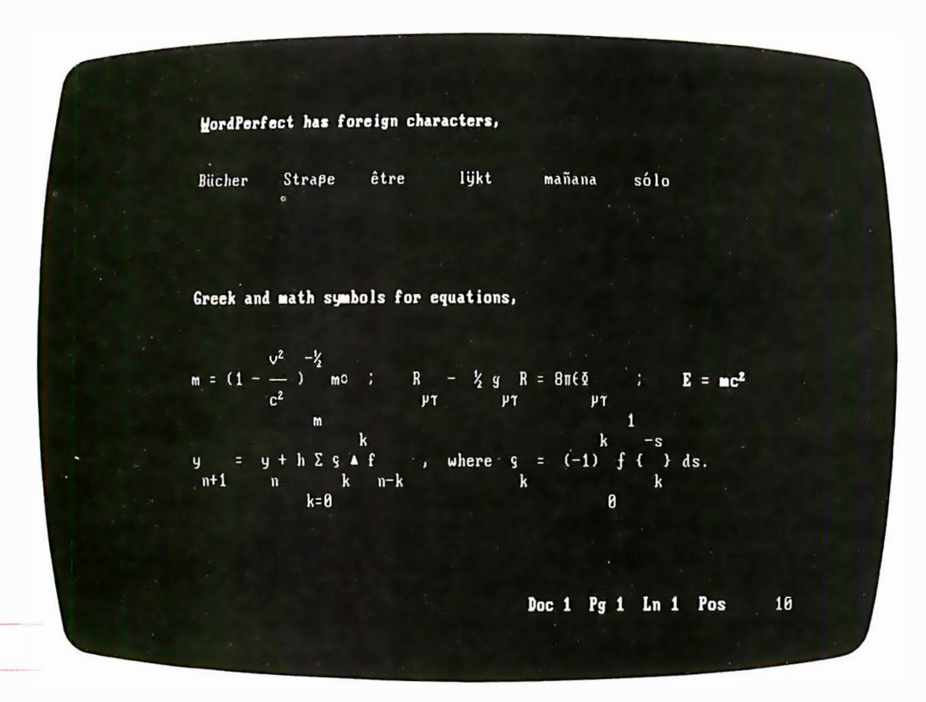


Photo 2: *Some of the foreign characters and mathematical symbols available with WordPerfect.*

One of the best ideas in WordPerfect is "what you see is what you get." In order to insert commands to boldface, underline, or center text, you press a function key and the text appears bold (highlighted), underlined, or centered. Nothing in this program interferes with your thoughts (see photo 1). If you need to see the hidden formatting commands, you use the reveal functions command (Shift-F2). One caution: because of the way in which the character-attribute bit for underlining is manipulated, any characters underlined on a monochrome monitor will appear in blue on a color monitor; if fed by a color video drive board, they will appear in reverse video on the monochrome monitor.

WordPerfect also lets you select in which colors you would like your background and text to appear. You can change color combinations before starting your word-processing session by entering WP/S (WordPerfect, slash, System) from a DOS prompt. (This is how you change basic system default parameters from one session to another.)

With IBM's built-in international/mathematical-character screen-mapping capability, you can easily set up WordPerfect for French, German, Oxford English, or mathematical Greek (see photo 2). Screen mapping refers to "what you press is what you should get," unless previously redefined. This means that if you need an A-umlaut you should get one. One method of adding accents to your printed text is with overstrike. This involves typing a letter, A for example, then Shift-F5 (overstrike), and finally an accent, such as a double quotation mark for an umlaut.

FORMATTING

All word processors get your thoughts down on paper. The best ones make

(continued)

AT A GLANCE

Name
WordPerfect

Type
Word processor

Manufacturer
Satellite Software International
288 West Center St.
Orem, UT 84057
(801) 224-4000

Computer
IBM PC (and compatibles), Victor 9000, DEC Rainbow 100, Zenith Z-100, Tandy 2000

Other Versions
Personal WordPerfect, also for the IBM PC, and WordPerfect Jr. for the PCjr

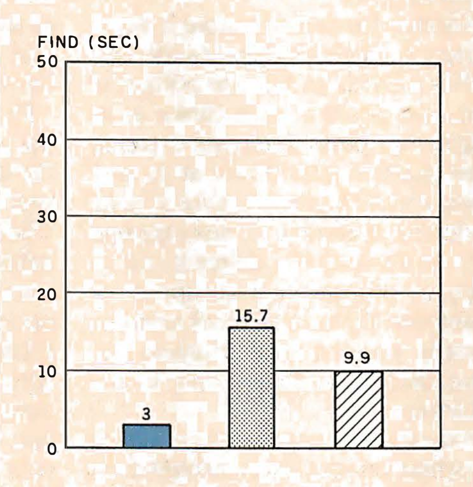
Disk Format
MS/PC-DOS 2.0, double-sided, double-density

Language
8088/8086 assembly language

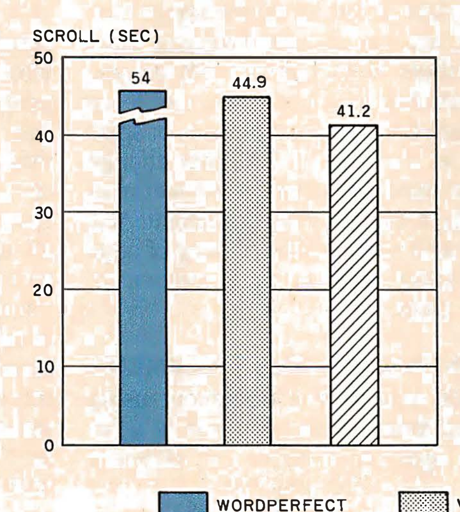
Documentation
Loose-leaf manual with index in a three-ring binder

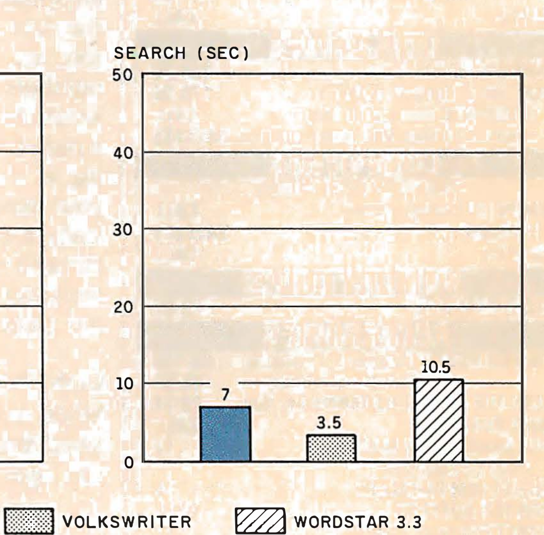
Price
$495











These graphs show the timing results of performing various standard word-processing functions using a 4000-word text file. The times are for WordPerfect, Volkswriter, and WordStar version 3.3. The tests were performed using an IBM PC with monochrome monitor.

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your thoughts look good. WordPerfect formats headers and footers: up to four of either or two of each. It also displays the current output page number by including a Control-N in the header or footer text.

Footnotes are taken care of almost automatically. Superscripted numbers and formatting are also taken care of within the program by using command keys. All you have to do is enter text. If you need to insert a footnote between two previously written footnotes, WordPerfect renumbers all of them for you.

Another formatting feature is WordPerfect's block-handling facility. To define a block, or discrete portion of text, you position your cursor at its beginning, press Alternate-0 (zero), then position your cursor at its end. Then you may print it, make it bold, underline it, save it to disk, append it to an existing file, delete it, cut or copy it, or convert it to upper- or lowercase. If you cut a block unintentionally, you can recall it unless you have defined another block in the meantime.

You can place page numbers almost anywhere on your page—centered, on the right or left, or on the top or bottom. You can also alternate your page numbers from right to left as you would find in a book. You can force a page break or reset margins or spacing at any time. If you later change your mind, WordPerfect will automatically reformat your document. You can also suppress the printing of page attributes, such as page number, on any page.

Controlling the Document

When you type a document using WordPerfect, what you see is what you get. A number of different methods will get your cursor from one end of a document to the other. Along with the normal Page Up and Page Down keys, you have single keys for screen up (the number pad "−" key) and screen down (the number pad "+" key). To get to the bottom of your document from anywhere in the file, you press Home twice and then down arrow. Getting to the top of a file is a similar Home, Home, and up arrow combination.

You scroll up and down with the "n" function. When you press Escape, you see "n =" at the bottom of your screen. The program is asking how many lines you want to jump at a time—the default is eight. You can change this temporarily by entering a number after pressing Escape and more or less permanently by using the WP/S command. You can also activate word-left and word-right functions by pressing Control-left arrow and Control-right arrow, respectively, as well as line-left (Home-left arrow) and line-right (Home-right arrow) functions.

Finally, you may go directly to any document page by pressing Control-Go To (the number pad 7, or Home, key).

Setting margins and tabs is a little indirect. First press Shift-F6 (set format). On the bottom line you see an options menu: Set Format? 1 Tabs; 2 E-Tabs; 3 Margins; 4 Spacing; 5 H-Zone; 0. Tabs and margins are both numbered from the absolute left position on the screen. In other words, if your left margin is 10, you will see your text lined up at the tenth character position from the left side of your screen. If you set a tab stop at position 15, this tab stop is actually five columns to the right of that margin. This gets confusing if you decide to change the left margin, for example, to 5. Your tab is still set at 15, which means it is now 10 columns to the right of your margin.

It is a good idea to set up a series of tab stops across the width of your screen. Tab positions are available through column 158 with regular tab settings, and farther beyond to column 250 by using E-tabs. Unfortunately, to set tabs with WordPerfect you must stop what you are doing, figure out where you want a tab, then set the tab stop. You cannot merely indicate that you want a tab in the column where your cursor is.

Spacing in increments of half a line is accomplished from the same options menu as tabs and margins. The

(continued)

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H-Zone on that menu refers to the hot zone, an area around the right and left document margins that is used to determine hyphenation and word wrap. When a single word in your text goes beyond the hot zone, you are prompted to position the hyphen where you want it and then press Escape. You can hyphenate your text as you enter it or use the WordPerfect option to leave out the hyphenation help.

FILING THE DOCUMENT

Once you write a document, you will want to save it. WordPerfect's file management offers several options conveniently grouped together.

The system commands or file utilities include commands to save, rename, or delete a file, check its size in bytes, and display the space available for file storage on your disk.

You can also save documents as straight ASCII (American Standard Code for Information Interchange) text files. This is a savings because you don't have to buy a dedicated ASCII text editor to build program files for compilation. WordPerfect does the job just as well. It also simplifies transferring files from one computer using WordPerfect to another using a different word-processing program, or sending a file electronically, such as through electronic mail.

WordPerfect supports MS/PC-DOS 2.0's tree structure very well. You can change the default directory or drive at any time. When you call them up, the program displays disk-file directories alphabetically, including file size in bytes and time and date information. You can call up a list of files from within a directory with a wild-card search—using the asterisk to represent any character or characters—and then retrieve, rename, delete, or print them. WordPerfect also lets you save a file encrypted under a password.

PRINTING

WordPerfect does all its printing in the background, working from a queue, while you edit another document on the screen. You have full access to all the word processor's functions while printing is going on, though they can run a little slower than usual.

The program works with almost any printer available, serial or parallel. There are 32 types of printers already defined, including the old faithful line printer. If your particular printer is not on the list, you can easily set it up with the included Printer.EXE program.

Printing column output is one of WordPerfect's strong points. You can define from two to five columns, spaced any way you like. If you want even spacing, WordPerfect asks how many spaces to put between the columns and then calculates each column's right and left margin. You can also break columns up on a page, such as when you want a headline and then text in columns, as in galley sheets.

Finally, WordPerfect supports true proportional spacing under program control. It uses WordPerfect's automatic incremental spacing commands, which you define when you set up your printer. If your printer supports super- and subscripts, WordPerfect can use that capability for footnotes and mathematical formulas.

MATH, MACROS, AND MERGE

WordPerfect boasts some of the most extensive math capabilities of any word-processing program I know. It has the normal arithmetic functions (addition, subtraction, multiplication, and division) and more. While it is not a spreadsheet in the sense that you know electronic spreadsheets, you can perform the common arithmetic operations between columns (and rows) and display the result in a different column (or row) as shown in photo 3.

You can use math functions almost anywhere in your document. A math section can extend over page boundaries to column 250 and can contain both numbers and text. This makes putting together a professional-looking balance sheet or financial report easy. As a matter of fact, Satellite Software International claims to use the math functions included in WordPerfect to store its own monthly accounts.

Often in word processing you need to do the same thing over and over again. WordPerfect can be taught to remember a series of keystrokes, file them, and retrieve them as needed.

(continued)

```
You can even do calculations in WordPerfect.  I will set up
the following table so that column #1 will be multiplied by
column #3 and give us the total in column #4:

Quan    Description          Price    Total

  5     Tables              245.00      !
 20     Chairs               50.00      !
 17     Tablecloths          12.50      !
 43     Dinner Napkins        2.95      !

                                        +

After calculation:  (the ! and + are functions and will not print)

Quan    Description          Price    Total

  5     Tables              245.00  1,225.00!
 20     Chairs               50.00  1,000.00!
 17     Tablecloths          12.50    212.50!
 43     Dinner Napkins        2.95    126.85!

                                    2,564.35+

                          Doc 1  Pg 7  Ln 1  Pos     10
```

Photo 3: *An example of the row and column calculations present in WordPerfect.*

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For example, I have defined a macro called "envelope." When I write a business letter using the normal business form of address at the top, the macro almost automatically writes that address on an envelope for me.

You can chain macros under WordPerfect. This may occur conditionally depending on the success or failure of a search operation. It may also occur repetitively, as when you search for a phrase and each time the phrase occurs you want to perform one action, and when the search fails, you want to perform another.

One of the most work-intensive functions of a word processor is writing a form letter. Putting the names and addresses in correct order and repeating a name or part of an address within the body of the letter is difficult with some word processors, but not with WordPerfect. The program treats each line of the address—name, street, city, zip code—as a field. A complete name and address is treated as a record, and you can repeat any field in the record within the body of your letter as often as you wish, personalizing it with the addressee's name or city, for example.

WordPerfect handles the merge in the following way. First, you create the file (name and address records) and save it; then you enter your form letter. When it is finished, you initiate the merge (Shift-F9) and WordPerfect executes it. When the merge is com-

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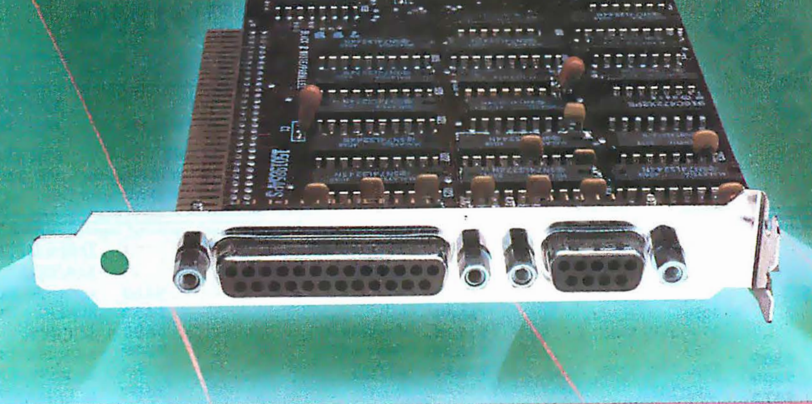
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plete, you can print the letter.

You can use this same file of names and addresses to print out mailing labels—either one-up (a single strip of labels, one label across) or several across on a sheet of labels (using WordPerfect's column printing capabilities).

Spelling Dictionary

WordPerfect's spelling dictionary comes bundled with the program and is almost integral to it, but it is only 30,000 words long with room for an additional 10,000 user-installed words. It also suffers somewhat from its implementation.

The dictionary lets you check the spelling of the current word, all the words on the current page, all the words in the current document, or a specific word or template you supply. (Template refers to a prefix, followed by a dash, that retrieves all words beginning with those letters.) If the program finds an error, it is not immediately corrected. Rather, the program asks if you would like to look up the word in a list of suggested spellings or correct it yourself now. While this method more or less forces you to learn the correct spelling of the words you use most often, it would be more efficient to have the program offer you a list of words from which you could select the one you want.

As you check the spelling of words in a document and the dictionary comes to one it does not know, you have the options of continuing, updating the word into the dictionary, correcting the word, or looking it up. This brings me to another problem. If you need to look up the word "disarmed," for example, it appears in the first dictionary lookup screen for words starting with "dis." However, you cannot exit the dictionary lookup area until you have viewed three and a half more screens. It doesn't take that long to get through the screens, and the words are alphabetized and easy to find, but it is still an unnecessary annoyance.

Summary

I have been using WordPerfect and its updates almost every day since I bought version 2.3 in the spring of 1983, and I have found it to be a capable, easy-to-use word processor. Like all software packages, however, it has both good points and bad points.

On the plus side, because it has been scaled down (rather than up) to the 16-bit microcomputer, WordPerfect can fully use the capabilities of the IBM PC. Also, its use of virtual memory lets your document be as large as your memory with all parts

(continued)

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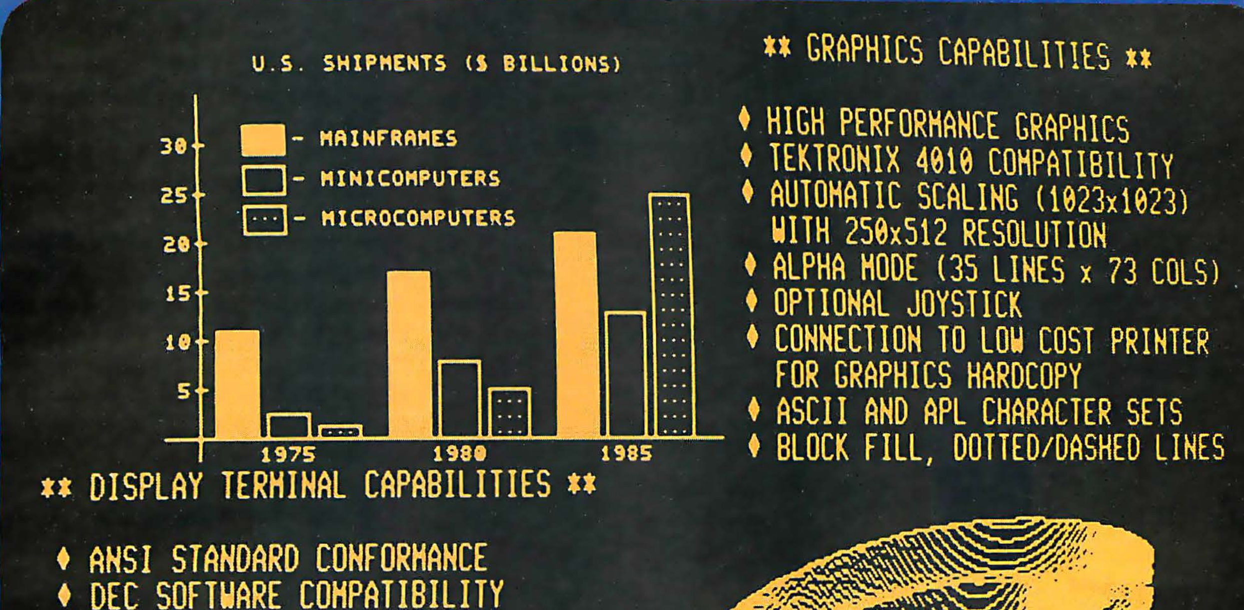
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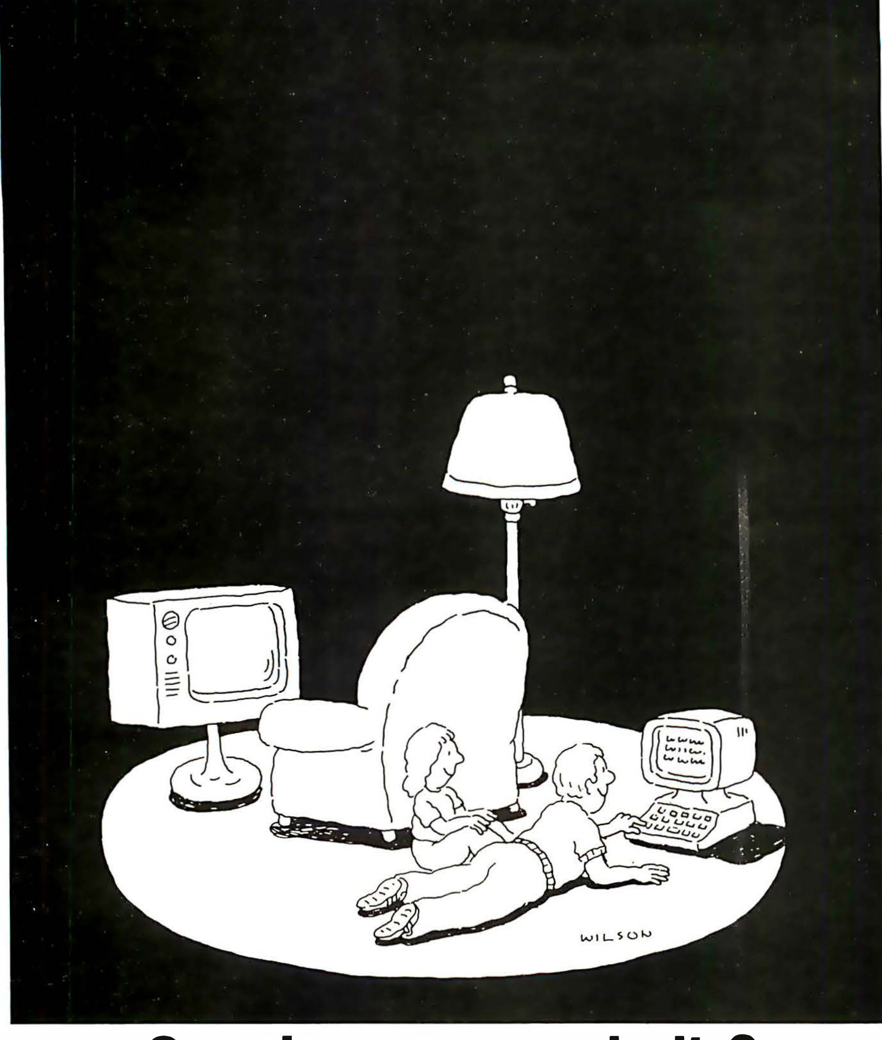
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of it accessible to the program at any time without action on your part. The "what you see is what you get" approach lets you see bold, underlining, centering, and margins on the screen as they will appear in the printed copy. You can select your own screen colors, both background and text. And if you don't like the ones you chose yesterday, you can change them today. Finally, you can use WordPerfect both as a word processor and as a program text editor because of its ability to save documents as straight ASCII text files. This saves you both money and the time, effort, and confusion involved in switching back and forth between editors.

On the minus side, the character-attribute bit for underlining is manipulated differently for monochrome and color monitors (this might not be a problem, depending on your application). The tab stops are established relative to a zero screen position, so if you change your left margin, your tabs all change with respect to that margin. Setting tabs in WordPerfect is a chore because you must stop what you are doing, figure out where you want a tab, and then set it. Also, the spelling dictionary is only 30,000 words long with room for an additional 10,000 user-defined words. If it does find an error, WordPerfect asks if you want to look up the word in a list of suggested spellings or correct it yourself, rather than correcting the word automatically. And, no matter where you find the correct spelling for your word, you must continue to peruse any additional screens containing words that meet your search criteria. [*Editor's note: Satellite Software International has scheduled version 4.0 of WordPerfect for release about the time of publication of this article. It might solve some of the problems mentioned by the author.*]

All in all, I am extremely impressed with WordPerfect. Its powerful capabilities far outweigh the problems mentioned. As I said at the beginning of this article, you should choose the word processor that includes the features you find most convenient. My choice is WordPerfect. ■

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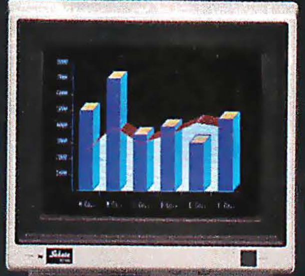
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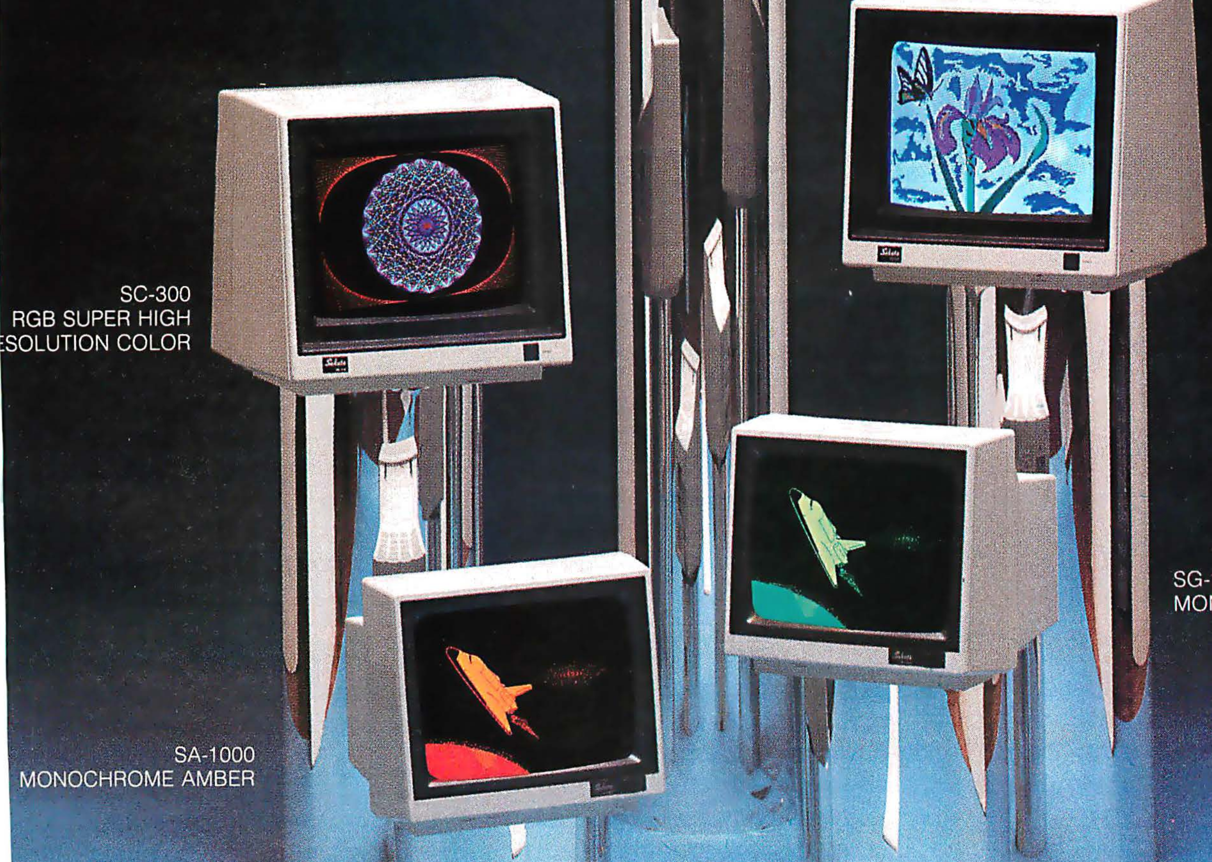
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H·A·R·D·W·A·R·E R·E·V·I·E·W

The Epson LQ-1500

A double-duty dot-matrix printer

BY KEN SHELDON

Dot-matrix printers are fast and inexpensive and produce output that can literally be a pain to read. Daisy-wheel printers are easy on the eyes but hard on the pocketbook, and they usually don't print much faster than you do.

Enter the Epson LQ-1500—a dot-matrix printer that attempts to provide the best of all possible worlds: speed, legibility, and affordability.

The LQ-1500 has three print modes: a high-speed draft mode, a lower-speed "letter-quality" mode, and a high-resolution graphics mode. The unit also features proportional spacing, a variety of type styles, international character sets, a 2K-byte buffer, and the capacity to print user-defined character sets. The cost is $1395.

FIRST LOOK

The LQ-1500 is a well-designed product, similar in looks to the earlier Epson MX-100 and FX-100 printers. This 31-pound machine is not one that you will want to move a lot. Like Epson's MX and FX series printers, the LQ-1500's controls are on the top right, next to the paper-feed knob. The on/off switch, however, has been moved from the right rear (as on the MX-80) to the left rear, which is somewhat less convenient.

Setup of the LQ-1500 is very easy, thanks to a well-designed manual that guides you step by step through the process, with clear illustrations accompanying each procedure. Even the trickier tasks usually performed by the dealer, such as installing the optional tractor-feed unit or the parallel, serial, or IEEE-488 interface board, should take no more than a few minutes with the help of the manual.

On the back of the unit are the interface, power connection, and two sets of DIP (dual-inline package) switches that allow you to initiate and disable the buffer, automatic line feed, and alarm bell, and to control print modes and character sets. All of these tasks can be controlled from your computer, which is good, since the sheet guide makes the DIP switches a little hard to reach.

PRINTING

The LQ-1500's major selling point is its variable print modes. For routine work there is a draft mode, which is fast and produces the usual "dotty" looking output. The letter-quality mode provides easier-to-read type by utilizing all 24 of the pins in the LQ-1500's print head. I must admit that I was annoyed with Epson for calling the higher-quality mode "letter-quality"—a term that has come to be associated with daisy-wheel printers, which the LQ-1500 is not. "Near letter-quality" or "virtual letter-quality" would be more accurate.

Nomenclature aside, the LQ-1500 produces a nice, dark, moderately smooth typeface. It isn't daisy-wheel quality, but it is better than the "emphasized" or "enhanced" modes of this and other printers, and infinitely better than usual dot-matrix printouts.

According to the manual, the LQ-1500 provides 224 different printing styles—which sounds pretty good, until you realize that the styles are all varieties of pica and elite in italic, compressed, emphasized, double-strike, enlarged, and underlined modes (see figure 1). I suppose it is nice to have all those options, but the differences between some of them (such as "elite emphasized expanded" and "elite double-strike expanded") are negligible. Also, some of the styles get pretty silly, such as "elite condensed emphasized double-strike" (which is barely legible) and several varieties of "compressed expanded" type.

GRAPHICS

The LQ-1500 was designed to be compatible with Epson's FX line of printers. I used it to print single-, double-, triple-, and quadruple-density graphs using the FX-80 printer driver in Lotus 1-2-3 with no trouble (see figure 2). I was also able to produce graphs

(continued)

Ken Sheldon is a technical editor for BYTE. He can be contacted at POB 372, Hancock, NH 03449.

AT A GLANCE

Name
Epson LQ-1500

Manufacturer
Epson America Inc.
3415 Kashiwa St.
Torrance, CA 90505
(213) 539-9140

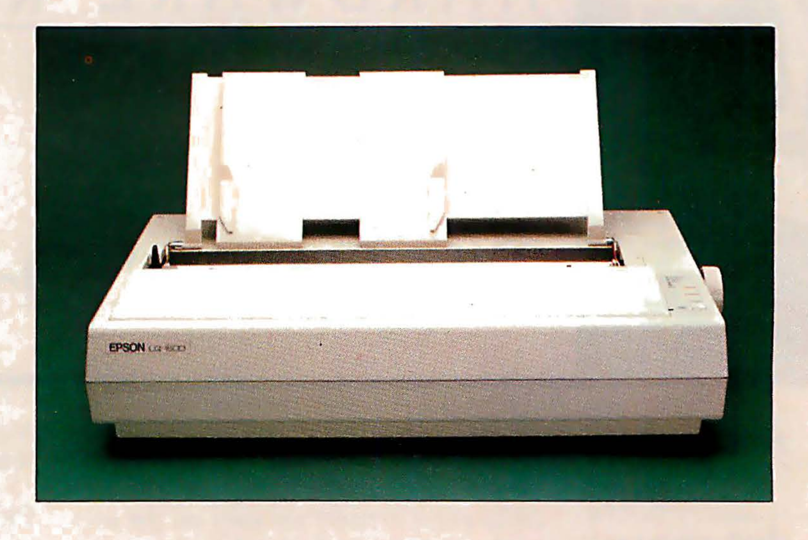
Physical Dimensions
24 by 14 by 5 inches,
31 pounds

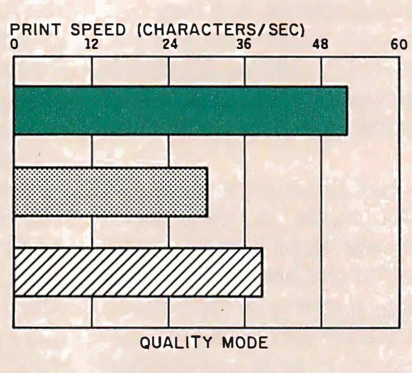
Features
Draft (9- by 17-dot characters at 116 cps), letter-quality (15- by 17-dot characters at 52 cps), and graphics modes (240 dots per inch horizontally by 180 dots per inch vertically); 2K-byte buffer; friction paper feed; parallel, serial, or IEEE-488 interface; compatible with FX-80 printer; will accept 128 user-designed characters

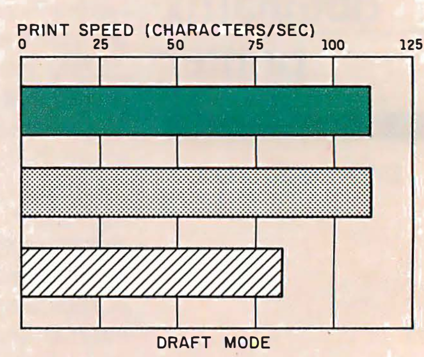
Options
Tractor feed ($55)
LQ-1500 Programmer's Manual ($17.50)

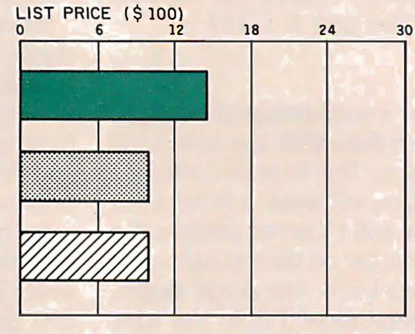
Documentation
LQ-1500 user's manual, spiral-bound, 97 pages;
quick-reference card

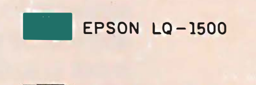
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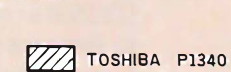












This is the Epson LQ-1500, letter-quality
This is the Epson LQ-1500, dot-matrix mode.
This is the Texas Instruments Omni 800/Mod
This is the Texas Instruments Omni 800/Mod
This is the Toshiba P1340 in high-quality
This is the Toshiba P1340 in high-speed mo

A comparison of the Epson LQ-1500 printer with the Texas Instruments Omni 800/Model 855 and the Toshiba P1340. All three are high-density dot-matrix printers. Print samples are given for both the quality and draft modes. The TI Model 855 sample was obtained by using the Courier WP print module. A printing pitch of 10 characters per inch was used for each test. In the print-speed tests, each printer was programmed to print 50 lines of 80 As each. The prices shown include a tractor-feed mechanism.

Pica regular
Pica emphasized
Pica double-strike
Pica italic
Pica underlined
P i c a   e x p a n d e d

Elite regular
Elite emphasized
Elite double-strike
Elite italic
Elite underlined
E l i t e   e x p a n d e d

Figure 1: *The Epson LQ-1500 offers pica and elite type in a variety of styles.*

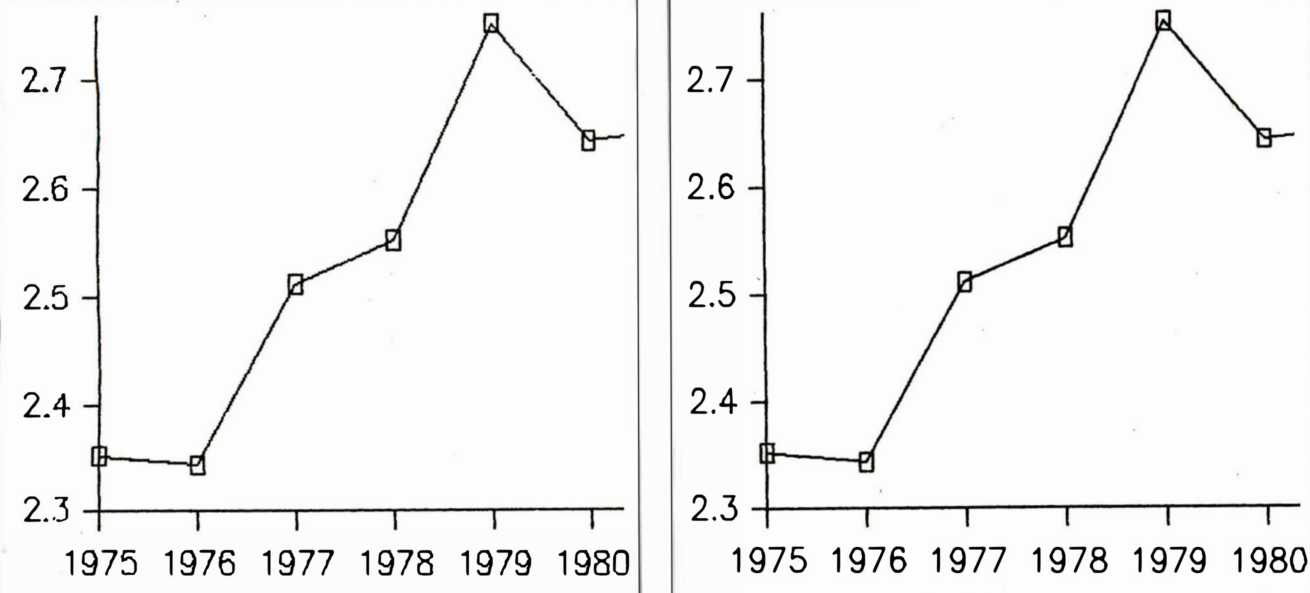


Figure 2: *Quadruple-density graph printed by the LQ-1500 using the Epson FX-80 printer driver on Lotus 1-2-3.*

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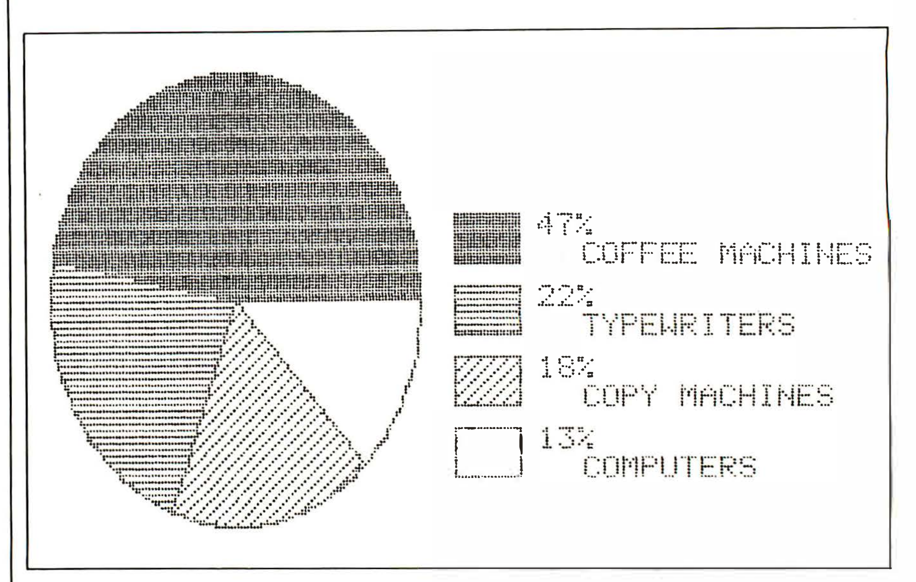


Figure 3: A *pie chart generated by pfs:*Graph *and printed on the* LQ-1500.

by using the Epson printer driver in pfs:Graph (figure 3).

Documentation

One of the best things about the LQ-1500 is its small, spiral-bound user's manual. The manual is short, clear, and includes a good index and a quick-reference card. Sections on control codes, commands, changing print styles, and so on, are also included. And if you want to design your own character sets or write special software for the LQ-1500, you'll have to get the *LQ-1500 Programmer's Manual* ($17.50), which should be available by now.

Unfortunately, there are a few mistakes in the user's manual, such as confusing pica with elite on a couple of the print-style charts, and using the words "condensed" and "enlarged" on the quick-reference card and "compressed" and "expanded" in the text. These are the exceptions, however, and overall the manual deserves high marks.

Operation

Epson claims that the LQ-1500 will print 200 characters per second (cps) in draft mode and 67 cps in letter-quality mode. If you have any experience with real-life printing, you know that this is wishful thinking. In one of BYTE's standard benchmark tests for dot-matrix printers (printing the letter A 80 times in 50 rows), the LQ-1500 operated at 115.6 cps in draft mode and 52 cps in letter-quality mode—not bad, since the letter-quality mode is faster than some printers' draft modes and much faster than most daisy-wheel printers (see "The Art of Benchmarking Printers," by Sergio Mello-Grand, February BYTE, page 193). But it is just as noisy as other dot-matrix printers.

Another operational feature is the 2K-byte buffer, which is enough to store all the information from one screen. For certain kinds of short, repetitive printing that require input from the keyboard, this can save time, but you usually won't notice the difference.

Conclusion

At $1395, the Epson LQ-1500 is more expensive than most dot-matrix printers, but it provides features that the others don't have. And although there are printers that do double-duty printing for less money, they don't have the Epson name.

For a printer as versatile and easy to use as the LQ-1500, the price is not bad. And if "virtual letter-quality" type is acceptable for your needs, then the Epson LQ-1500 may be the printer for you. ■

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Speech and Voice Synthesis

I found Tom Clune's "Speech and Voice Synthesis" text box for the "Five Voice Synthesizers" article (September, page 337) to be a concise account of the problems of voice synthesis from the computer's point of view, but a linguist he ain't. In fact, the first three paragraphs were quite painful to read.

Voiced sounds (those in which we use our vocal cords, like vowels and m, n, b, r, etc.) and voiceless sounds (those for which we do not use our vocal chords, like s, sh, f, h, etc.) both have amplitude peaks and a frequency range and thus identifiable formants. If they didn't, our ears could not distinguish the differences between them. Thus, the voiced/voiceless distinction is one of degree only.

The concept of allophone is a central concern in speech synthesis. Simply defined, allophones are different realizations of the same basic sound. For example, the "p" sound in "pat" is measurably different than the "p" sound in "hypnosis".

A phoneme, in general terms, is a minimal unit of sound that cannot be changed past the allophone limit without changing the meaning of the word. If we changed the "p" to "f", "pat" would be "fat". The differences in "p" and "f" are too great for them to be allophones; they are different phonemes.

As an aside, the "oy" in "foil" is not an allophone, it is a diphthong. A diphthong is two vowels that, when taken together, can serve as the nucleus of a syllable and can receive stress as a unit.

Now the interesting part: The occurrence of allophones is determined by the environment in which the basic sound occurs. In other words, it is predictable that the "p" in "pat" will have a puff of air after it, as all "p"s do when they are followed by a vowel. Because allophones are predictable, they are programmable. The stiffness and artificiality of today's voice synthesizers is due in large part to the lack of allophonic variation in the phonemes, as well as other word- and sentence-level stress and intonation phenomena that are largely predictable by linguists.

Speech synthesizers and voice-recognition programs will not approach "naturalness" until the predicted changes in the speech stream are indeed programmed.

Michael R. Thomas
Port Arthur, TX

Certainly if unvoiced sounds lacked formants there would only be one unvoiced sound. To repeat the point I made in the text box, the origin of the sound is, in essence, white noise. The creation of formants is a function of vocal-tract resonances, not of the original sound. An analogy may help clarify this point. A drop of water falling into a gallon jug will seem to make a lower sound than a drop of water falling into a dropper bottle. The difference is in the resonance of the container, not the sound the drop makes. However, it is true that the voiced/voiceless distinction is not absolute. The "zh" sound in "azure," for example, straddles the voiced/unvoiced boundary. The linear predictive coding (LPC) model treats the boundary as absolute, which is one of the simplifications involved in the model.

Second, I did not call the "oi" sound an allophone, but a phoneme. This is in agreement with the standard linguistic classification schemes, e.g., Fries-Pike and Trager-Smith. Diphthongs are one type of phoneme.

—Tom Clune
Technical Editor

Four Logos

In his review of "Four Logos for the IBM PC" (August, page 287), Mr. Bridger overlooked the fact that in the Dr. Logo editor, one can continue a statement over several lines by indenting subsequent lines. Thus, if condition [action1] [action2] can also be expressed

```
if condition
  [action1]
  [action2]
```

Formatting can make Logo procedures much more readable. TLC Logo, from The LISP Company, also allows formatting.

He also pointed out that Dr. Logo's primitives are case-sensitive. The same is true for IBM Logo. The difference is that Dr. Logo's primitives are lowercase, while IBM Logo's primitives are uppercase.

There are some typos in listing 2. The reader should insert >, >, >, =, and = at appropriate places in the five IF statements.

Mr. Bridger is to be commended for his useful review.

Roger B. Kirchner
Northfield, MN

Sorry about the typos. One of our word processors stopped printing the characters > and = and nobody noticed in time to fix the listing.

—Rich Malloy
Product-Review Editor

Fujitsu Micro 16s

I feel it is necessary to clarify and update several points made in the recent BYTE review "The Fujitsu Micro 16s" by Alex Pournelle (October, page 246).

The author said the Micro 16s doesn't come with BASIC; in addition, I was misquoted as saying: "the business marketplace doesn't need or want BASIC." The fact is, application programs and programming tools are essential to the business marketplace and Fujitsu has a wide range of business software and programming languages currently available, including CBASIC, which have been available since May 1984. Fujitsu's target market for the Micro 16s is primarily the business professional and its focus is to provide business solutions and productivity tools for its users.

Fujitsu offers multiple operating systems, CP/M-86, MS-DOS, and, most recently, single or multiuser Concurrent CP/M-86. The software offerings include SuperCalc3, WordStar, MailMerge, SpellStar, DR Graph, a variety of languages and mainframe communications packages including ACCULINK, Micro SNA/3270, and BIS-3780, all available in MS-DOS format.

In addition, more than 250 business software packages are available that have been tested by Fujitsu for performance on the Micro 16s family of personal business computers.

Referring to Fujitsu's documentation, Mr. Pournelle stated that, in some cases, it was lean or inadequate. Fujitsu has recently

(continued)

undertaken the task of improving and enhancing its documentation.

Other than the minor points clarified above, we are pleased with the fair and favorable review given our product.

CLAUDIA NATALIA
Marketing Communications Manager
Fujitsu Microelectronics Inc.
Santa Clara, CA

LISP FOR THE IBM PC

The software review "LISP for the IBM Personal Computer" by Jordan Bortz and John Diamant (July, page 281) contained the kind of high-quality writing that originally prompted my subscription to BYTE. I would like to congratulate these authors on a very understandable overview of the LISP language and a well-considered critique/comparison of muLISP-83 and IQLISP. I would like to see more articles on artificial-intelligence applications in the future.

My only criticism of the article is of figure 1 on page 286 that depicts a list visualized as a tree. Although I was amused by its content ((JOHN AND JORDAN) HACK (C AND LISP)), I believe it to be an incorrect representaton of the list as shown in listing 1 on page 282, which is (JOHN (AND JORDAN) HACK LISP). "C AND" is not present in the original listing. Furthermore, the tree depicts three objects: the list (JOHN AND JORDAN); the atom HACK; and the atom LISP. The listing actually contains four objects: the atom JOHN, the list (AND JORDAN), the atom HACK, and the atom LISP.

The concepts of atoms and lists are the basis of LISP. Unresolved confusion at this point could turn off someone's interest rather quickly. This criticism aside, I thoroughly enjoyed the review.

LAWRENCE ROUTHENSTEIN
Manayunk, PA

The theme of our April 1985 issue will be artificial intelligence.

—Rich Malloy
Product-Review Editor

ECO-C COMPILER

I read Jack Purdum's letter (August, page 310). He has a good point about the need for a long integer benchmark. The following is my contribution.

Listing 1 is a C program to find factors of a number. Factoring very large numbers is not a trivial task. Public-key cryptography systems depend on that difficulty to give them their security. The algorithm

Listing 1: A *long integer benchmark in* C *that finds a factor of a number.*

```
/*
** factor.c—a long integer benchmark in C
*/
#include          "stdio.h"

#define BIGNMBR 1394761   /* number to be factored
*/

long p = BIGNMBR;
long x, y, cnt, gcd ();

main ()
{

   puts("Factoring...");
   cnt = 0;
   x = y = 3;
   while (gcd(y-x, p) < 2)
   {
       cnt++;
       x = (x*x + 2) % p;
       y = (y*y + 2) % p;
       y = (y*y + 2) % p;
   }
   printf("A factor of %ld is %ld\n", p, gcd(y-x, p));
   printf("It took %ld iterations\n\n", cnt);
}

/*
** gcd—greatest common divisor of a and b
*/

long gcd(a, b)
long a, b;
{
long q, r;

   if (b < 0)
          b = -b;
   if (a < 0)
          a = -a;
   if (a > 0)
   {
          b %= a;
          if (b == 0)
                  r = 0;
          else
                  r = 1;
          while (r > 0)
          {
                  q = a/b;
                  r = a - q*b;
                  a = b;
                  b = r;
          }
   }
   return (a);
}
```

in the listing is called the Pollard rho algorithm. My program is derived from a Pascal program that appeared in *Pascal Applications for Sciences* by Richard E. Crandall (John Wiley & Sons, 1983).

I think this program is a good one to use to examine the quality of the implementation of long integers among various versions of C. It uses most of the operators applicable to the long data type—addition, subtraction, multiplication, division, and modulus—as well as passing long integers as function arguments and returning long values from functions. My choice of BIGNMBR is arbitrary. It is the square of the prime number 1181. This value produced short execution times, so I didn't get too bored; however, it isn't short enough to cause errors in hand timing, which would cause significant errors in the result.

Table 1 gives my results for running the benchmark on two popular versions of C: Aztec CII and Ecosoft's Eco-C. The methodology used in preparing these results was the same as for my original article: all timing was done by hand. For compilation, assembly, and linkage, timing was started when the command line was entered, and it was stopped when the system prompt reappeared. Execution timing was started when the program sign-on message appeared and stopped when the sign-off was displayed. These benchmarks were run on a 4-MHz Z80 system with dual 8-inch double-sided double-density disk drives. When completed, the program prints

A factor of 1394761 is 1181
It took 871 iterations

The Eco-C version reported on in the table was compiled with the -i compile-time option. This causes a version of the printf function that does not format real numbers to be linked into the executable file. When the program is compiled without the -i option, the code size is 9470 bytes, which is roughly comparable to the code size produced by the Aztec compiler. I also timed assembly and linkage of the Eco-C program using the

(continued)

Table 1: *The results of running the benchmark in listing 1 with the Aztec and Ecosoft compilers. The code sizes are reported in bytes. The Eco-C, Z80asm assembly and link times were obtained using an optional high-speed assembler and linker.*

Compiler	Comp.	Assem.	Link	Size	Execution
Aztec	0:25	0:20	0:45	9096	2:06
Eco-C	1:08	0:24	0:52	7280	1:41
Eco-C, Z80asm	1:08	0:12	0:24	7280	1:41

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optional high-speed assembler and linker. As you can see, the improvement is significant.

David C. Clark
State College, PA

WANTED: News on HP 110

The purpose of this letter is to request any evaluation/review information available on the HP 110 portable computer, related accessories made by Hewlett-Packard.

Thanks in advance for any independent review information that could be made available.

P. C. Smedes
Tampa, FL

A review of the HP 110 will appear in the January issue.

—Rich Malloy
Product-Review Editor

Statistics

In the September Review Feedback (page 358), Jerry M. Lefkowitz stated: "The point is, if you enter only N significant digits in your input data, you cannot get more than N significant digits in your answers."

Not so. For instance 1/7 = 0.142856, and all six digits can be significant to the internal computation, regardless of the external lack of trailing zeros. A familiar example is temperature conversion from centigrade to absolute. A temperature of 6°C = 284°K, and presto! we turned one significant figure into three.

Worse yet, Anders Celsius would convert the 6° into 94°, because he had the scale upside down. (See Webster's Unabridged Dictionary under "centigrade.") So 1-, 2-, or 3-figure accuracy is merely an artifact of the way you measure a quantity.

Steven J. Rhodes
Willoughby, OH

Mr. Rhodes raises an interesting, and sometimes confusing, point about significant digits. But the fact still stands that the number of significant digits in a result is equal to the number of significant digits in one's data. Most people assume that the number 1 is equal to 1.000000. . . .

To a scientist, a single-digit measurement such as 1 is usually assumed to represent some indeterminable value between 0.5 and 1.5. In the same way, 7 represents a value between 6.5 and 7.5. The result of the division of these two measurements, 1/7, then lies somewhere between 0.5/7.5 and 1.5/6.5, or between 0.066 and 0.23. This rather large range is approximately represented by the value 0.1. A resultant value of 0.142856, though mathematically correct, would suggest undeserved precision in one's original measurements.

—Rich Malloy
Product-Review Editor

REVIEW FEEDBACK is a new column of readers' letters. We welcome responses that support or challenge BYTE reviews. Send letters to Review Feedback, BYTE Publications, POB 372, Hancock, NH 03449. Name and address must be on all letters.

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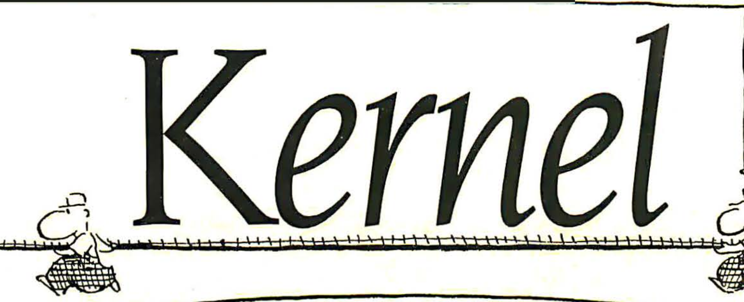
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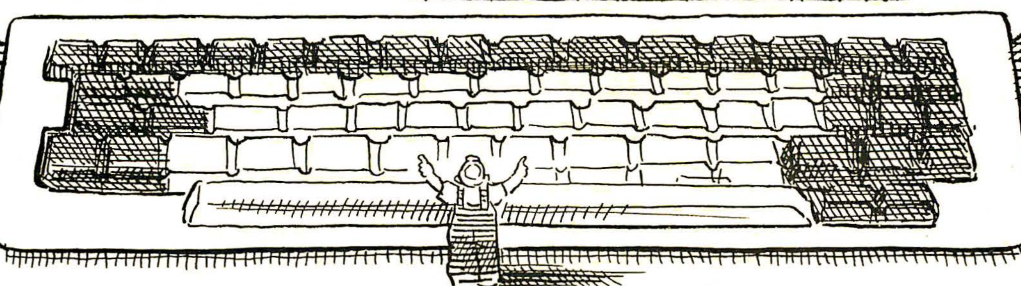
THIS MONTH, JERRY POURNELLE recounts an equipment-repair episode, falls in love with the HP LaserJet printer, begins a quest for a clock board, and has his son Alex take a close look at the TI Professional Computer.

The BYTE West Coast staff reports on local-area-network standards, Digital Research's Concurrent PC-DOS, and the import of IBM's acquisition of Rolm Corporation.

From London, Dick Pountain describes micro-PROLOG, a microcomputer version of what is to a degree the highest-level computer language yet devised.

In Tokyo, Bill Raike takes a look at some hand-helds, previews the Big.APL portable, and discusses MSX computer standards.

And in Circuit Cellar Feedback, Steve Ciarcia replies to reader letters about Circuit Cellar projects.





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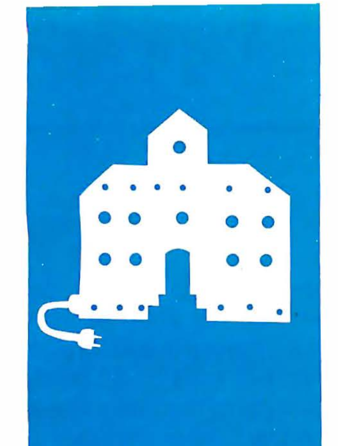
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COMPUTING AT CHAOS MANOR

Home Again

BY JERRY POURNELLE

Jerry Pournelle holds a doctorate in psychology and is a science-fiction writer who also earns a comfortable living writing about computers present and future.

It's over. August saw: the completion of *Footfall* (by Larry Niven and Jerry Pournelle; Ballantine Del Rey Books, June 1985); the publication of *The User's Guide to Small Computers* (by Jerry Pournelle; Baen Books, 1984, and if you don't like these columns you'll hate it); the World Science Fiction Convention in Anaheim (Gordon Dickson, Guest of Honor; Jerry Pournelle, Master of Ceremonies); and, in early September, the BYTE Computer Show in San Francisco, where I was a speaker. It was mid-September before I could come up for air.

ZORRO RISING

Zorro, our Z-100, is something between a working machine and an experimental box. We depend on him for a lot of our work. Zorro is the host for the wonderful Disk Maker I that allows us to transfer files from nearly any 5¼-inch disk format to nearly any other, and since the Z-100 can take 8-inch disk drives without modification, we can also transfer to and from 8-inch, as well as 5¼-inch, disks. On the other hand, he gets an awful lot of experimental boards, ROMs (read-only memories), memory chips, and other stuff installed in him.

Alex tried to install a new board and discovered that the machine didn't work. He'd followed all the usual safety precautions, but Zorro's keyboard wasn't sending control characters—and saw only 128K bytes of memory instead of the 192K bytes installed.

We were all worried. Of course, three Disk Maker I jobs awaited. (Faster than a speeding modem! More powerful than a copy of Transporter! Able to leap from MS-DOS to CP/M in a single bound! This is a job for Disk Maker I!)

Zorro's long been out of warranty, but as it happens we've never had any trouble with him at all, so we didn't know where to take him. Naturally, this happened just before the World Con, so we had little time to deal with the situation. A quick call to the West Coast Zenith distributor produced a recommended repair facility, and off he went.

The news was horrible: they wanted to replace both the motherboard and the keyboard at a cost of $500 and $300, respectively. This didn't seem reasonable. Zorro had problems, but there hadn't been any smoke, and there was surely no visible damage. We retrieved him, paying $20 for the diagnosis. Now the World Con was only one day away.

"Take him to a Heath store," I suggested. "In fact, why didn't we do that in the first place?"

"Because," Alex and Peter explained patiently, "they're remodeling the one in downtown L.A., and the Woodland Hills Heath place is doing double duty while that happens, and they can't promise quick action."

I could understand that, but $800 seemed pretty steep, and besides, we wouldn't need Zorro during the World Con anyway; so off he went to the Woodland Hills Heath store.

Heath's backlog was mostly illusory. A week later Zorro was fixed. One bad chip and one broken wire in a cable. Total cost: less than $100, including both diagnosis and repair. That's the first repair in more than a year-and-a-half of intensive use, including being carried about through the house, transported across town several times, and a half-dozen dissections for installation of new stuff. It's certainly not an unreasonable repair bill.

The moral of the story should be plain: the first place we went didn't really do repairs; they merely tested boards (and didn't do that very well, since they thought the problem was the keyboard rather than the keyboard cable). They had the facilities to replace boards, but they didn't even try to do anything else. The Heath stores were able to get in and see what was really wrong.

Pournelle's rule applies: If you don't know what you're doing, deal with people who

(continued)

do—and make sure they *do* know what they're doing.

LASERS!

I first saw the Hewlett-Packard LaserJet printer at COMDEX in Las Vegas. The printer is based on the Canon cartridge-copier system. It has the Canon sheet feeder, connects to your system with a 9600-bps (bits per second) RS-232C serial connection, and prints eight pages a minute. It's also quiet.

I thirsted for one.

In mid-August I got a conference call: Bill Godbout, president of CompuPro, in Oakland and Steve Rose of Capacity Inc., a CompuPro Systems Center in Kahului, Hawaii.

"Good news," Dr. Godbout said. "We have the HP LaserJet working with the CompuPro 10." (The 10 is his silly name for the multiuser Shirley that has become the workhorse of Chaos Manor.)

"Better news," Steve said. "I can ship you one this week. Interested?"

"Works like a bomb," Bill Godbout said. "We want one here, but Steve's a fan of yours and wanted to offer you the first shot—"

"Stop!" said I. "How much?" They told me. I gulped. It wasn't cheap. I went to consult the checkbook. After all, we *had* just finished *Footfall*, the acceptance payment had been authorized, and I hadn't bought any presents for Shirley and Zeke II in some time. "Done," says I.

It arrived just before World Con, of course. That's all right. Bill Godbout *still* doesn't have his. We unpacked it, and Peter took almost 10 minutes getting it hooked up to Shirley, after which it ran like a charm. It did listings and printed WordStar files just fine, and if you tell WRITE that it's a standard Teletype simpleminded printer, it does WRITE files. The only catch—you must set WRITE's sheet length to 60 lines, instead of the standard 66. For some reason, HP set the default that way.

Enter Barry Workman. "If you let me have it for a week, I'll take it to Noor Singh, and he'll do some custom software for WRITE," says Barry. "After all, you're going to the World Con, and up to San Francisco, and you'll have it back before you return, and ——" He held out a glass of Armagnac.

Two glasses later, his arguments sounded so reasonable that I let him take the printer away. I got back last night. They tell me I'll have my printer back tomorrow.

Meanwhile, they've made some discoveries.

It underlines fine. To make it do boldface, we'll need an alternate character set, which comes in a ROM cartridge. (Actually, it tries to do boldface, but it just prints the same letters twice—accurately.) There also seems to be some problem with proportional spacing of the kind WRITE uses (the WordStar method of justifying line-ends works fine for either WordStar or WRITE). The machine is said to have a whole bunch of different type fonts, but I have only one.

The paper-feed tray holds only about 80 sheets of paper, meaning that you have to reload it every 10 minutes or so.

The print-intensity control on the side doesn't do a damn thing; Canon insisted on putting it in. The LaserJet doesn't use the same cartridge as the Canon personal copiers.

But it runs like a bomb, silently printing eight pages a minute in *beautiful* black characters on any quality of paper you like.

I think I'm going to be in love.

BASIC COMPATIBILITY FOR THE Z-150

Mrs. Pournelle has taken over the Z-150 and normally allows no one to touch it, but she saw an ad for the

(continued)

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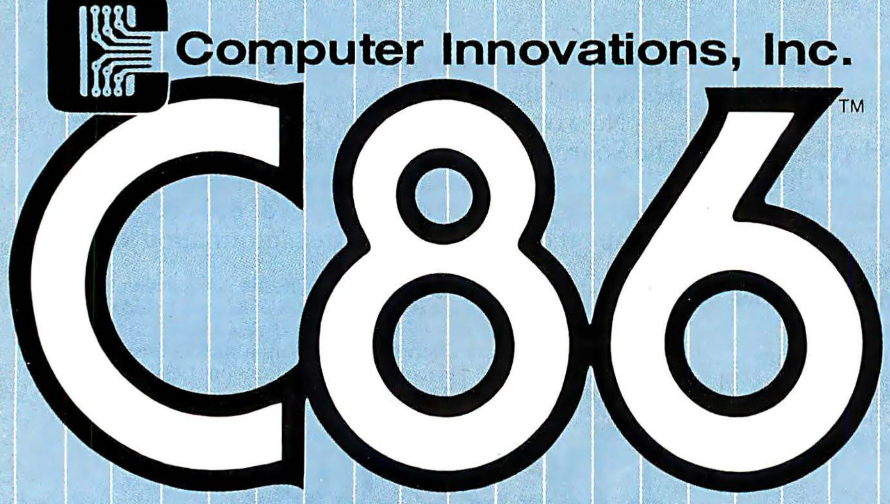
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KoalaPad and wanted that. (Not surprising: the KoalaPad is great fun, easy to use, and one of the better enhancements for your machine.) We had it here at Chaos Manor. Alex was drafted into installing it on the Z-150. Here is his report on some curious phenomena.

"Through some oversight, we never received any software from Zenith for the Z-150 IBM PC clone. That hadn't bothered us; we just used our IBM PC disks. They all worked just fine—for the first six months we got along without. Then I tried to hook up the KoalaPad to it and discovered it needed BASICA.

"'No problem,' thought I, 'I'll just get a copy from Lucy Van Pelt (the IBM).'

"The result wasn't quite as I expected: the Zenith went slightly gaga! It printed a long series of graphics characters, bells, letters, and other extraneous matter and then went dead. Really dead: the old Ctrl-Alt-Del sequence wouldn't reboot it.

"At first I blamed the KoalaPad software: 'Hmm, must be a bad disk.' But I tried to run BASICA alone and got the same result. I knew the program was all right; it had run on the IBM.

"Right then I should have remembered the problem but didn't. I called Rachel Klau, our friend at Zenith who wrote Zenith's BASICA and other Z-150 software.

"'IBM BASICA won't run on the Z-150, Rachel!'"

"''Alex, I'm disappointed in you! What happens to the IBM if you turn it on without a disk?''"

"'It waits for a disk for a while, then it runs built-in BASIC.'"

"''None of the compatibles, not even the Compaq, have—or can have legally—BASIC in ROM. IBM's BASICA calls routines in those ROMs. That's why its BASICA is shorter than ours.''"

"Now it came back to me. I felt a bit silly, having forgotten that IBM's ROMs include a number of BASIC routines.

"Rachel arranged to send us BASICA. The upshot is obvious—IBM-compatible still means that you must buy Zenith's BASICA; you can't use the IBM's. Note that compiled BASIC

programs, such as Cygnus's Star Fleet I and Bruce Tonkin's My Word!, seem to work just fine without the Zenith BASICA. Most interpreted BASIC programs run once you install the Zenith BASICA.

"As promised, we received both BASICA and Zenith's DOS 2.0. The KoalaPad software, when tried, booted just fine—but didn't listen to the KoalaPad. I called Koala Technologies' service department.

"The current KoalaPad software is for the IBM PC only. It doesn't say PC-compatible, nor will it run on them. That software is being developed."

I don't know what Koala's software does, but it must be pretty specific to *not* run on the IBM PC clones, especially one designed as carefully as the Z-150. Zenith went to great lengths to make the Z-150 compatible; this is the first major incompatibility we've found. More when we know more. For now, all you compatible owners beware.

The Great Clock-Board Quest

Mrs. Pournelle grew weary of typing in the time and date when she booted the Z-150—complaining (correctly!) that we didn't have to do that on the IBM, TI PC, or CompuPro. So off went Alex to get a time-and-date board, possibly with some memory, for the Z-150.

Upon arriving at Priority One, he discovered there was only one in stock—the STB RIO PLUS board, which we have in Lucy Van Pelt. Upon return, he plugged it in the Z-150, set the memory switches, and booted it.

The Zenith's self-test program said there was bad memory in the new block. Alex swapped for known good chips—for a programming major, he sure fixes hardware—and tried again. Same result. Called Priority One.

Mike, the showroom technician, thought the RIO PLUS board was good, but it just wouldn't work in the Zenith. Alex brought the board in, and during World Con Mike tested it. The RIO PLUS board was fine but didn't work in Mike's Z-150, either.

(continued)

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The upshot is that we're getting a Quadram Quadboard instead. Those successfully run in the Z-150. Jean, the Priority One assistant sales manager, was extremely patient with us, but no one offered an explanation of why some boards will not work in the Z-150.

Incidentally, I'm willing to bet that when Zenith's Mark Foster reads this, he'll brood until he finds a way to Do Something; the Zenith firmware crew really work at keeping the Z-150 compatible with the PC.

This compatibility business can be tricky. My best advice is to either look for the Zenith list of tested hardware (which we didn't do, alas) or deal with places that don't mind taking stuff back if it doesn't work.

Discounted Services . . .

On that score: Priority One sells good stuff at big discounts. The only way it can afford to do that is by cutting service and support to the bone. That can result in some pretty unfair impositions on full-service (and full-price) computer stores, such as ComputerLand.

The people at Priority One protest that they do have a hardworking service department. I agree. This is one of the best of the by-mail discount houses. However, on their margins they *cannot* hold novices' hands.

Indeed: one ComputerLand manager tells us that perhaps 25 percent of his support requests come from people who buy boards from Priority One and then discover they don't really know how to install them.

There's another problem. A customer comes to a computer store, one that employs knowledgeable salespeople. After several hours of analysis of the client's requirements, the store recommends a system—and discovers that the customer has checked the Priority One catalog and wants the equipment for those prices.

It won't take long for stores to go broke that way. In the old days, we complained that computer stores didn't employ knowledgeable salespeople. Some still don't. Those that have taken the trouble to hire and train good people get ripped off by customers out to save money at the store's expense.

This isn't a diatribe against Priority One or the other discount houses, nor am I trying to talk computer companies out of selling to discounters. Hobbyists, hackers, and others who know what they're doing don't need full services at full prices and ought to have lower-price sources. On the other hand, those who *don't* know what they're doing shouldn't really expect costly advice for nothing, and constant attempts to get support without paying for it is driving the full-service stores out of business.

It has got so bad that one store suggests contracts with customers: either buy the equipment at the store or pay a consultation fee. That policy has obvious problems, but I can't offhand think of anything better.

The problem is real. Suggestions are welcomed.

Lilith

In the midst of our hectic August, Lilith arrived. We were glad to see her, since we'd returned our Diser (and the Diser Company vanished into Chapter 11).

Lilith is the computer designed in Europe to Professor Niklaus Wirth's specifications. She has Modula-2 built into her microcode. There's a mouse, fast bit-mapped screen, great graphics, mediocre to crummy documentation, a pretty hefty software library, and a keyboard that looks an awful lot like the DEC VT-100 keyboard. There's a full review in the September BYTE on page 300.

Lilith does everything the Diser did, and more. She has a real Winchester hard disk (instead of the washing-machine Honeywell-Bull cartridge hard disk the Diser sported) and a 5¼-inch floppy disk for backup and

(continued)

George Tate, RIP

He got started as a technician back in the early days of the micro revolution. Noor Singh, who knew him in those days, says he was always conscientious and eager to give customers more than their money's worth. George Tate was one of the first to recognize that immense fortunes could be made from microcomputers.

Before he was well into his thirties he'd started a software chain that became one of the industry's largest. Then he read my review of a program called Vulcan, decided it could be marketed, and arranged to publish it as dBASE II.

The program sold well, making Ashton-Tate (there wasn't any "Ashton"; George thought a hyphenated company name sounded better, and he and his partner, Hal Lashlee, agreed that "Ashton" sounded better than "Lashlee") one of the giants of the industry. When George bought Vulcan, he was offered all rights; but he chose to leave the original author a hefty percentage of the profit to encourage him to maintain and expand the program. That turned out to be a wise decision.

In the old days, George, my late mad friend Dan MacLean, and I used to get into violent arguments on where this micro revolution was (or should be) taking us. We soon spilled over into discussions of his own company's policies. No matter how loud the argument, George always listened to our suggestions and was unfailingly polite. He gave copies of dBASE II to a half-dozen charities and scholars on my recommendation. After I complained about his license agreements, he rewrote them. For a while I thought George would publish Tony Pietsch's WRITE program, and I still wish they'd been able to come to some agreement.

He was only 40 years old when he died of a heart attack on August 10. Ironically, one of the papers on his desk was an employment application from Noor Singh.

We'll all miss him. George was one of the good guys.

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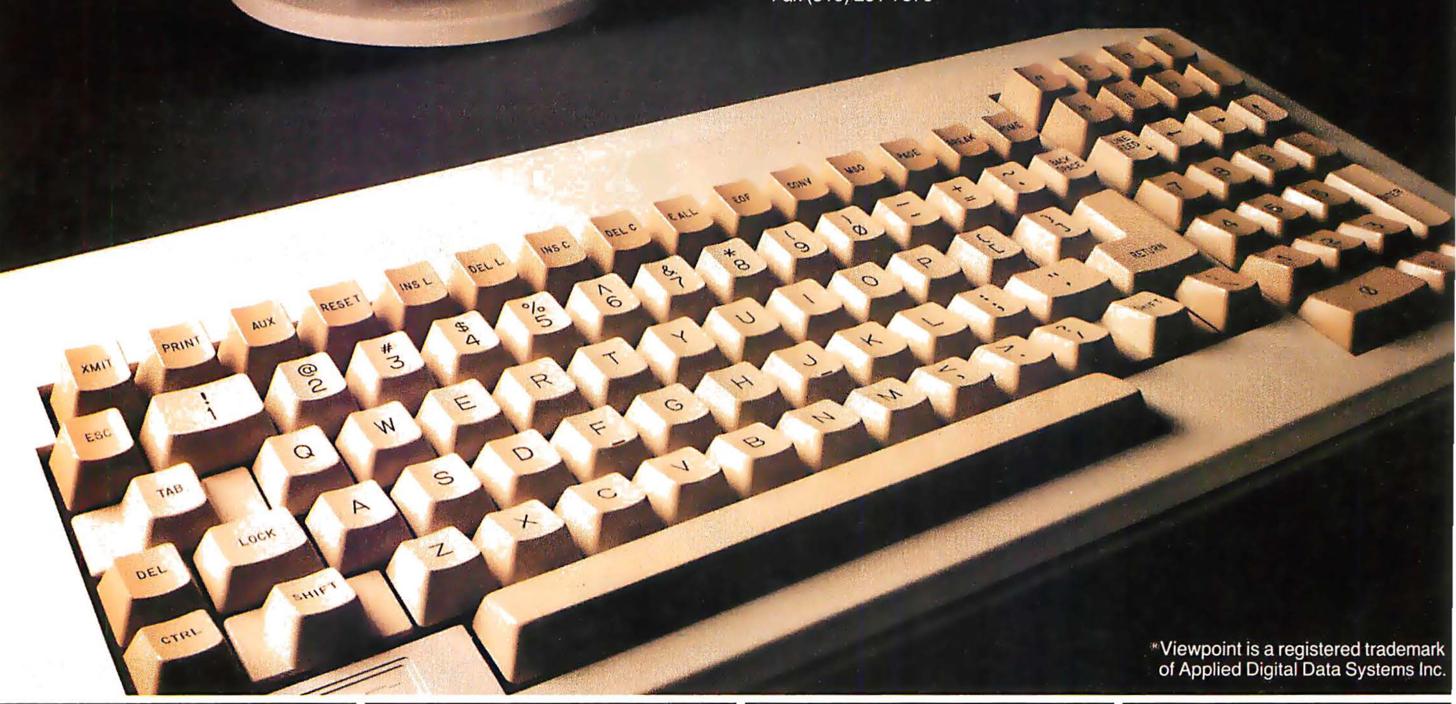
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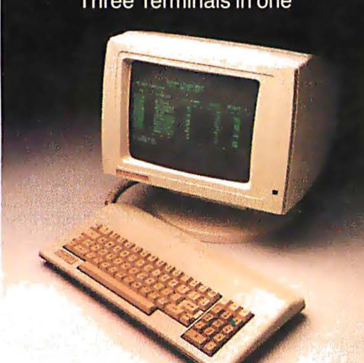


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Our Lilith is very quiet. Her three fans just barely make any noise.

transferring programs. It took Alex about two hours (and a phone call to Provo, Utah) to get Lilith set up; as Modula Corporation improves the documents and shipping crates (I never saw so much foam rubber and plastic worms in my life), the setup time and complexity ought to come down, but it's hardly onerous now.

Once set up, Lilith will play chess (although we can't find any documents for the chess program; the computer knows how to castle, but we can't figure out how to get the machine to let the *player* do it) and pool (the same game the Diser played). She'll also do terrific text editing, and they tell me they'll have software to let Lilith drive my HP LaserJet Real Soon Now. (She can already work with dot-matrix printers.)

Alex decided to modify an existing program, just to find out how the Modula development tools worked. He reports that there is a master program to call the editor, debugger, compiler, and the program under development; much like Turbo Pascal, this makes correcting bugs much easier.

Our Lilith has 128K bytes on four boards; you can get as much as 512K bytes for her. The boards, unfortunately, sit on a nonstandard bus designed specifically for Modula machines—you can't buy boards from anyone else. There is an extra serial port, though.

Lilith is very quiet. Her three fans just barely make any noise. That's very welcome here at Chaos Manor, where we've considered learning Navy semaphore to converse when all the computers are on at the same time.

Lilith was intended to be an idealized workstation for generating Modula-2 programs, and that's why we have her. Dr. Michael Hyson and I are doing a book on Modula-2, and I intend to have lots of examples. From the little experimentation I've been able to do, Lilith ought to let me get the book out about twice as fast. I expect you'll hear a *lot* more about Lilith in future reports.

More Modula-2

Hurrah! Logitech now has a version of Modula-2 for the IBM PC and clones that produces stand-alone code. The code size and speed aren't much to brag about yet; Logitech is working to do optimizations. Still, they're comparable to some of the Pascal compilers on the market. (My apologies for being vague; I've barely had the compiler in the machine long enough to verify that it will, indeed, turn out stand-alone .EXE programs. A complete report when I've had a chance to do real tests.)

Another good machine for playing with Modula-2 is the Sage IV with the Volition Systems Modula-2 and ASE editor. This runs p-code only and thus is slow. You can do practical programs, but you'll wish there were a 68000 native-code compiler.

Alas, there isn't one. A story goes with that . . .

Revolution at Volition?

For months, Volition Systems people reported that they would have a native-code stand-alone Modula-2 compiler for the 68000 chip Real Soon Now. Indeed, for several months it was always "next month."

Then, during August, there was a general shake-up of Volition Systems. Several people who had formerly worked there (and still owned stock) formed a coalition able to muster a majority of voting stock just before the company was supposed to go public. The result was that Joel McCormick, A. Windsor Brown, and Richard Gleaves (otherwise known as Glitch) have left the company. Lawsuits are rumored. As I write this, the 68000 native-code compiler seems further away than ever.

I wish I had better news. With a Modula-2 native-code compiler, my

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Sage IV would run like gangbusters. Sigh.

APPLE MODULES . . .

After Lilith arrived, I called up Professor Richard Ohran of Modula Corporation. You may recall that Richard is also director of the nonprofit Modula Research Institute, which distributes much public-domain Modula-2 software; Modula Corporation sells Lilith and other Modula-2 hardware, hopefully for a profit. During our discussion, Prof. Ohran mentioned his Modula-2 package for the Apple II.

Understand: I do not yet have this package, so I can only report what Ohran told me. On the other hand, I've known him several years now and I've never been fed any hype, so I have every reason to believe him.

According to Ohran, they have developed a Modula package that includes a language card and software. The package doubles the memory and quadruples the speed of the Apple II—and works with the Apple accelerator. The package, plus an accelerator, lets an Apple with Modula-2 outperform an IBM PC. Moreover, you can develop and compile programs on Lilith, then download to the Apple.

This all sounds wonderful. I can hardly wait to test it out.

Flash: Modula Corporation also has a Macintosh compiler complete with toolbox for $90. It looks superior to Mac Pascal.

SUCH A DEAL . . .

Bruce Tonkin is a software wizard. He works mostly in Microsoft BASIC because of its portability; and he can do wonders. Of course, he makes copious use of pointers and indirect variables and the like, and he often uses his highly structured PBASIC pre-compiler (it compiles to Microsoft BASIC, which can in turn be compiled with Microsoft's BASCOM compiler). His results are amazing.

For example: his My Word! word-processing program has some features not found in *any* other text editor I've ever seen. His Creator database-generation program is simple to use, runs splendidly on a variety of machines, and was, to my knowledge, the very first outside-developed application program for the Macintosh.

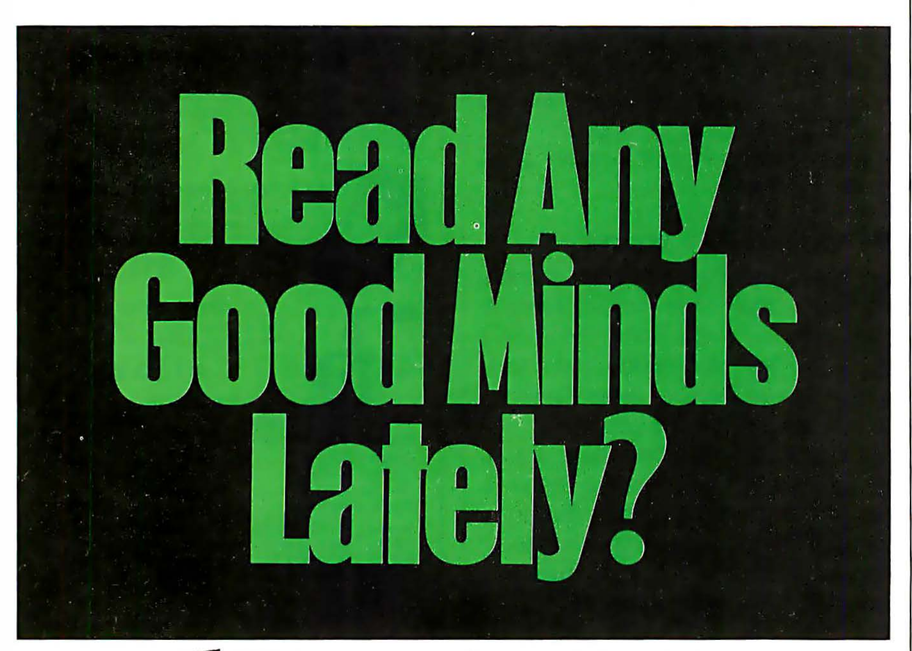
Alas, Bruce will do no more work with the Macintosh. Although Apple professes to be eager for Macintosh software, Bruce has been unable to get Apple to do more than look at Creator, which has never been put on Apple's list of Macsoftware. Maybe it's because Bruce is uninterested in spending the money to become a "certified developer." In a recent letter he writes, "All the little developers who made the Apple II popular are frozen out of the Mac market. How many can afford to lay down $6000 for a Lisa on top of what they paid for a Mac, then pay Apple $500 so they can get answers to technical questions and $150 for a preliminary technical manual set?"

He's also annoyed that no Apple magazine seems interested in reviewing the Creator (although they will review programs that do less and cost more). Bruce thinks it's because he doesn't buy high-cost advertising; at his prices he can't afford to.

Indeed, his prices are one of his problems: many dealers refuse to carry Tonkin's T.N.T. software line because he insists that the prices be kept low, and many dealers believe they can't make any profits with such low prices. That's not as ridiculous as it may sound. Unless you're doing a very high volume of business, you need to make quite a bit on each sale.

There's another approach. Barry Workman has bundled several of Tonkin's programs into a package he calls The Software Essentials. The total price—about $125—is high enough that Barry can advertise it, sell it through dealers, support it, and

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make a profit. Bruce is happy, since the price per program is low. Of course, they both are betting that customers will also be happy.

Included in The Software Essentials are My Word! and My Word! extended (contains extended sort, global paragraph reformatting, and calculations; it's WordStar-compatible); 80-page manual plus NEW.DOC on disk; My Word!'s mail-merge utility, alias "MyMerge."

Textref: an indexing program that makes *very* complete indexes; too complete for large books but not bad for program documentation. It's a single-word indexer; for multiple levels, you have to do a bit of work by hand. Still, it does work well for a first pass, and the price is right.

The Creator and Reporter: with a newly reprinted 120-page manual. While these won't do everything that dBASE II will, they'll do a surprising amount of data management and report generation, probably as much as most users need.

Just to sweeten the deal, they've thrown in some utilities.

Compress/Expand: makes My Word! files smaller for disk storage. Much akin to the public-domain squeeze and unsqueeze utilities. I'd never use it myself, but it does seem safe and can save disk space.

Read: a typing program like MS-DOS's More. Unlike the TYPE command, the MORE command lets you move forward and backward by pages through the file.

Cheapsort: a low-price database-sorter program.

Xtrax: converts random or sequential files for mail merge, etc.

I'm told there are several other utilities, too.

All the programs will run on every model IBM, from PCjr through PC AT. They also will run on most compatibles; the utilities should run on almost all MS-DOS computers. My Word! runs on the TI PC, Zenith Z-150, and Tandy 2000, but not the Zenith Z-100.

As an instant software package it looks hard to beat: word processor, mail merger, sorter, database handler, and utilities.

After watching Philippe Kahn demonstrate his Borland International Sidekick with Lotus 1-2-3, I came to the conclusion that Sidekick plus 1-2-3 is at least as useful as Symphony; add the Workman T.N.T. package and you can turn your PC into one heck of a useful machine.

Big Tex

We've had our TI Professional for a couple of months; alas, busy months, which haven't given me much time to play with the machine. On the other hand, just as we were about to get to Big Tex, TI sent technicians out to rebuild him from bottom to top, so I'm glad we hadn't invested a lot of time in the old model.

Although I've been busy with *Footfall* and other novelistic matters, Alex has had the summer off and was able to put in nearly a full week with the Professional.

Alex talks mostly about hardware. The TI Professional is not an IBM PC clone, and most PC software won't run on it. That's the bad news. The good news is that dozens of the best programs, including Lotus 1-2-3, dBASE II, EasyWriter, BASIC, WordStar, and many others, have been specially rewritten for the TI, and many take advantage of the machine's special features. Programs adapted for Big Tex work very well indeed.

Now to Alex's notes.

The TI's Hardware

"Being the inquisitive type, I took the TI apart to look at its construction. I was impressed. Two screws hold on the top panel, at the upper corners of the rear panel. This is much better than the five that are inconveniently placed on the IBM PC. Once open, the TI is better looking, too. There's a spacer bar along the left-hand side of the cabinet so that the boards won't twist (which does happen on the IBM PC). The power supply is much larger than the IBM's, large enough to run all our boards, the Winchester, and one floppy-disk drive. (I'm told by TI engineers that it's not quite large enough to run another floppy-disk drive, but an even heavier supply is in development.)

"There is a whole lot of room under the Winchester and floppy-disk drives. There's actually enough that some enterprising individual could stick a half-height hard disk under the floppy-disk drive. (The speaker is under the Winchester drive, but of course that could be moved.) This, by the way, isn't so unusual: the Zenith Z-150 has much the same arrangement—intentionally designed that way.

"The machine had six boards in it: RS-232C board, memory-expansion board, TI's graphics board with three planes of memory, speech-command board, 300/1200-bps modem, and Winchester disk controller. The first two boards plugged into two separate connectors that are in a row, so the TI PC can be said to have "five-and-a-half" slots. The floppy-disk controller, parallel-port connector, 8088, and 128K bytes of memory are built into the motherboard of the TI PC. The modem board is built for TI by Racal-Vadic, an old minicomputer modem firm that now sells PC modems. All the other boards are built by TI (more on that in a moment).

"Most of the boards are thicker than normal. The modem board has a transformer that sticks out. If you add color to the TI PC, the extra graphics memory is put on a piggyback board—otherwise you have but one color. The speech board is two boards thick, but it has extremely large connectors that make it effectively three boards thick. I expect that new versions of these boards will be much smaller and draw less current."

Incompatibility

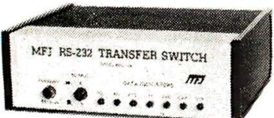
"The TI's bus, though it looks exactly like the IBM PC's, isn't compatible. TI

(continued)

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In a world of me-too machinery, the TI Professional is obviously different and thus more salable.

decided to move the bus lines around so that IBM cards wouldn't work in the Professional. This seemed to me like a pretty bad idea when I first heard about it—after all, TI had lost big on the TI-99/4A with much the same approach. But there was some logic to the decision, as I discovered later.

"If the Professional had had IBM-compatible slots, everyone would have thought it was another IBM PC clone. Customers would have rioted if they knew that boards could plug in but wouldn't work exactly as in the IBM. One of the main selling points of the TI PC is its high-resolution graphics; if TI had made the slots compatible, it would have had to make the graphics compatible (and therefore much lower resolution).

"While you can argue that compatibility isn't quite that cut and dried, you must admit that it was a smart move. In a world of me-too machinery, the TI PC is obviously different and therefore more salable. This, without going overboard in the other direction, as with the Victor 9000, Apple III, or NEC micros.

"This incompatibility meant that TI could include a much better display than the IBM's. Screen resolution is 720 by 300 pixels, with no display modes that I can find. The higher resolution, better character set, and larger screen make the display better than the IBM PC's if you compare color to color. Compared to the IBM monochrome, it's a toss-up, which is a compliment to the TI's color display."

[In any event, the TI has the only color display (under $10,000 anyway) I know of that you could use day after day for word processing. All the other color systems are too fuzzy and will give you (or at least me) eyestrain after a few hours. . . . J.E.P.]

The TI Board Crunch

"When we first got Big Tex, he had all six expansion connectors filled (see above); it's pretty tight in there. When Bill Cmela came out from TI, he replaced the two boards in a row (that's the memory and RS-232C boards, if you're keeping count) with a Persyst Time Spectrum board. The Time Spectrum board has a light-pen adapter, battery-supplied real-time clock, an RS-232C port, and space for up to 448K bytes of memory—which brings the TI PC up to 512K bytes. The light-pen adapter has the same connector as the monitor, so I labeled them both to circumvent confusion. The Time Spectrum board comes with software to automatically set the TI PC's time at start-up plus print-spooling and RAM-disk software. The clock was accurate to within a few minutes when I tested the board.

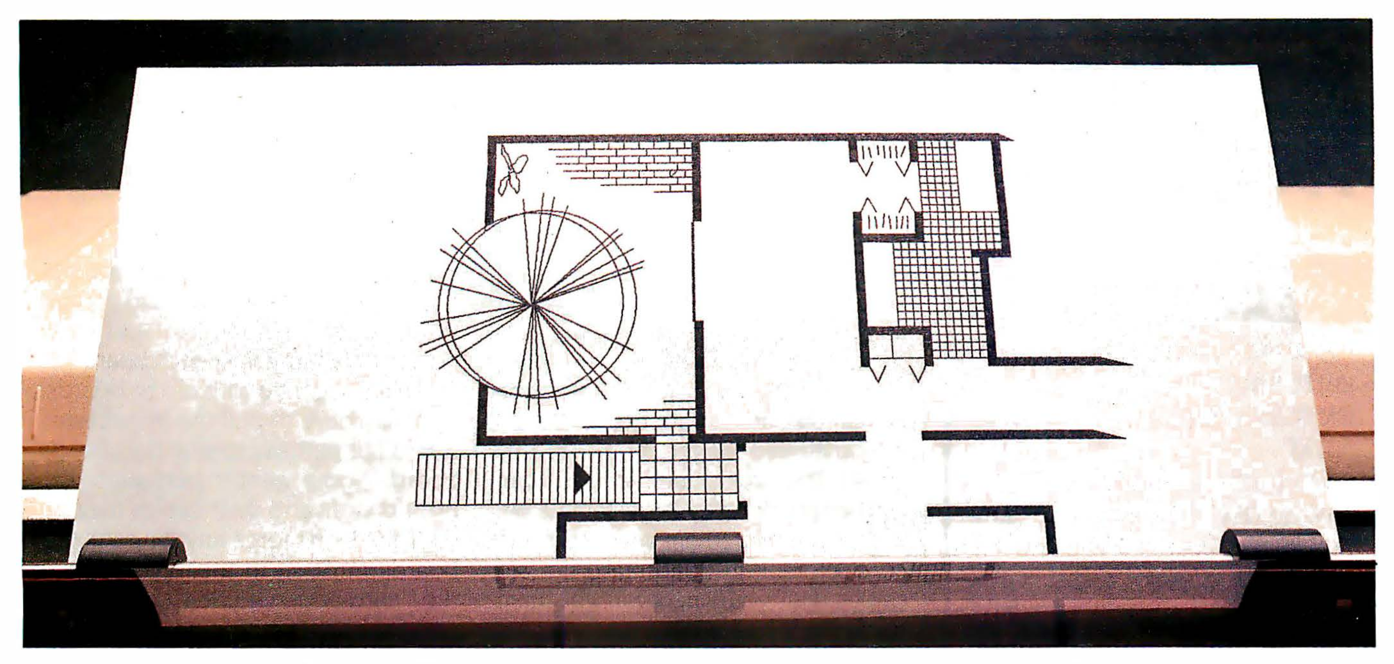
"The Time Spectrum board supplants the RS-232C and memory boards (the short ones in a row) plugging into *both* sockets, so it looks like two different boards to the TI. Unfortunately, Bill had to remove the modem board so that he could fit in the Persyst board—since the Time Spectrum board, with all its memory, is two boards hooked together.

"We were certain we wanted all five boards (which were around nine boards thick) installed, so it became a game of Chinese checkers, figuring out which boards would fit in which slots. One of the engineers at TI said that he didn't think you could physically fit all the boards into the box, but if you could, the power supply wouldn't complain. I saw a challenge, so I played with various configurations. Then the speech board wouldn't listen, so Bill had to come out again anyway. Between the two of us, we discovered a way to fit all of them in."

All the Boards Do Fit!

"People who don't own a TI PC are invited to skip this section; those who do will be happy to know that you can

(continued)



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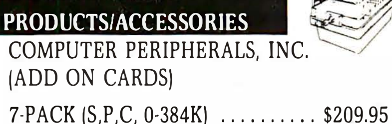


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fit all of those thick boards in your PC.

"Unplug the computer and take off its top. Take out the screw that holds down the Winchester controller board—that's the one nearest the floppy-disk drives with two cables on it. You'll need longer cables for this board. The cables needed are 34-pin card-edge socket to 2-row female pin connector and 20-pin with the same connectors. If in doubt, take the old cables with you when you get them made up. I had them made about a foot longer than the current ones. They were about $30, which is far less than an expansion chassis for the TI. You can get them made at most specialty computer supply stores. Radio Shack stores stock only cables for Radio Shack computers. (Make sure you notice the orientation of the connectors when you remove them; the new ones *must* be connected the same way. Also note what connectors are used; there are extras on the Winchester board. I don't know what would happen if you connected something backward or to the wrong socket, but I wouldn't want to find out.)

"Once you've got your new cables, here's how to fit all the boards in: first, make sure the power cord is unplugged. (You did that anyway, right?) The Time Spectrum (or memory) board goes in the first slot (as seen from the front of the computer). Next goes the graphics board, which you probably haven't touched. Next, route the Winchester cables between the power supply and drives, past the first slot where the Winchester board used to sit, between the card sockets and card guides. (The card guides sit up near the front of the cabinet and keep the cards from twisting.) Connect the cables to the Winchester board with the same orientation as when you took the board out. Give the cables a quarter-twist *gently*, so they won't be in the way of the next board. Then connect the wire from the speech board to the motherboard. If it's still connected, leave it alone. If the jumper has come loose, the speech-board hardware manual tells how to reconnect it. Now insert the speech board, taking care that the Winchester cables are out of harm's way—not between the cards and their card guides, nor between the socket and card edge, nor where the speech board will sit. Be very gentle with all the boards. You may have to pull the Winchester board out partially to seat the speech board. Some gentle persuasion of both boards and their cables may be in order. Don't force anything. All the boards must sit in their connectors, the card-edge guides, and their sockets or they (the cards) will twist. This is a no-no.

"Once these two boards are in place, make sure the Winchester cables aren't pinched and that no boards are touching. Then plug in the computer, turn it on, and boot up the diagnostic disk. Test the computer and the speech board. If all is working, you can put the modem board (or whatever's left over) in the last slot, put all the hold-down screws back in the boards, check for boards touching again, and put the cover back on. You've just saved yourself a lot of money."

Hard-Disk System

"Our TI has the optional 10-megabyte hard disk; as with the PC XT, the drive itself sits in the right-hand slot. The TI will accept hard disks from 5 to 30 megabytes. The hard-disk formatting program lists 10 different models.

"The only problem with that program is it's slow! It took 20 minutes to format and error-check our 10-megabyte drive. I'm glad you have to do it only once.

"I couldn't find a program to partition the hard disk for operating systems other than MS-DOS. I know that the UCSD p-System, CP/M-86, and Concurrent CP/M-86 are available for the TI, though.

"The hard-disk controller itself is an add-on board. Unlike the IBM, the TI's floppy-disk controller is on the motherboard, along with a parallel (Centronics) printer port. That means one more free slot.

"TI's hardware approach contrasts well with IBM's and Zenith's. IBM builds the keyboard interface, some

(continued)


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memory, a cassette interface, processor, and boot ROMs into the PC motherboard. TI adds a floppy-disk interface, diagnostic LEDs (light-emitting diodes), and the parallel port. Zenith's motherboard is more like an S-100 bus: nothing but power and data signals. All the functions, from processor through keyboard interface, are on add-on boards. On the one hand, the basic machine price can be kept low (as with IBM and TI). On the other hand, expansion is much easier—as with the Zenith."

TI Hardware Plans

"TI's own mouse is being approved by the Federal Communications Commission, but some third-party mice will work. Someone makes an expansion chassis for the TI, a product we'll probably need soon. Of course, Corvus makes an Omninet board for the TI, and several other local-area-network boards are available.

The TI Diagnostics

"Most computers come with a diagnostics or troubleshooting disk, but I've never seen a microcomputer with such good ones. Three LEDs are on the motherboard; these light up when the computer is too sick to boot. You can figure out what's wrong by reading the hardware manual. The computer gives itself a short self-test before starting up. Unlike the IBM PC, the memory test is tolerable even with 512K bytes in it. You may remember we disabled this test in the IBM PC because it took so long; we don't feel the need in the TI.

"The diagnostics disk is very good. I learned this by doing: I checked out the speech board before using it and discovered it wasn't listening to the headset. Yet it passed all 10 internal tests and it spoke, so I knew it was otherwise okay. A quick board swap later and all was well.

"These tests are so thorough that the extremely knowledgeable could fix moderately bad problems themselves. As it is, the diagnostics disk, plus operations manual, is enough for the beginner to isolate most faults. It insults neither beginner nor expert, which is a rarity among manuals. This goes for the software and other manuals, too. Many companies could benefit from manuals this good.

"A few complaints: there is no physical Reset button. Like the IBM PC, Ctrl-Alt-Del will reset the machine if it's listening to the keyboard. If a program crashes or turns off the interrupt that listens to the keyboard, this won't work. You must turn off the power, wait 20 seconds, and then turn it back on. That's extremely bad for both boards and the hard disk. The TI PC shares this deficiency with most IBM PC clones.

"Also: the cursor blinks about once a second, which is distracting. [Alex charitably calls it distracting. I call it maddening. . . .J.E.P.] I know this can be disabled because the speech program does so. I will have to plumb through the manuals for how to turn this off. Also, the Caps Lock on the keyboard (which has an LED, bless TI) goes on whenever you reboot. It must have been designed by an uppercase typist. A little program to set these would be extremely nice, especially if it would reset them between programs.

"On the hard disk: the model we have has no way to retract the hard-disk head. Later models have a landing zone. Also, I would really like a physical write-protect switch on it, just like on larger drives.

"The hard disk does make PC-DOS and MS-DOS easier to use. I set up separate directories for programs like WordStar, BASIC, and modem software, with path commands to search them. With buffers set to 30, the hard disk really moves. The TI would be a great development computer."

The Speech Hardware

"With the full name of the Speech Command System, this is a rarity. It's both a talker and a listener. You can dictate, dial and answer the phone, give voice commands to programs, use a voice password to lock out unwanted guests, set up appointment schedules, set alarms, and give yourself audio reminders. The board's vocabulary (on input or output) isn't good enough to actually transcribe your audio ramblings, but it is good enough for everything else. It's quite a board—I'm disappointed that it hasn't been accorded the publicity it deserves. [*Editor's note: The Speech Command System was reviewed in June, page 341.*]

"A word on I/O: the board comes with a microphone/headset that works well; a phone can also be used through the board. If neither suit you, you can use any good dynamic 600-ohm microphone with a ¼-inch plug. I'm using a Radio Shack cardioid microphone, catalog number 33-992B. You'll also want a good microphone stand; effective range is only about 3 inches. (There may be a way to adjust sensitivity of the input; I'm still learning.) With the external microphone, the board talks back through either the TI PC's own speaker or any 8-ohm external one.

"The speech system isn't perfect. Its quality could stand improving. Voices played back are discontinuous and somewhat garbled—less so with the external microphone than the headset. Both are a bit too noisy. Yet the board is still a great start.

"Voice data is recorded at 2400 bps. With data compression (speech is mostly silence) and a little better circuitry, I'll bet that TI could improve the voice quality considerably.

"You can change the speed of playback, much as with dictation recorders. Unlike them, however, the replayed voice tends to break up at high or low speeds—much like the discontinuity at regular speed.

"The Speech Command System requires a great deal of memory to run, both RAM and disk. The speech program itself is 161K bytes. A bit of arithmetic shows that floppies are quickly used up at 2400 bps with serious dictation. A hard disk is certainly in order for more than 15 minutes of dictation at a time."

Phone-System Software

"The speech program itself is broken into major selections: phone dialer, phone answerer, dictation system, and

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transparent keyboard software. I'll talk about each of these in a moment.

"This is one nice hunk of software. In fact, it almost has too many options. Let me explain.

"A problem that software developers must face is a user's experience. Unless he's going to restrict the software's flexibility (people will feel insulted), he must explain all of them. The more options, the more likely a newcomer will give up because it's too hard to learn. Yet people like me who want everything controllable will snub inflexible software. With the speech board's obvious target being the busy executive, I wonder if TI hasn't erred by putting too many features in the program. Of course, the gadget-mad person will love it and be patient enough to read about all its features. I'd love to hear how long it took other people to figure out this system.

"That out of the way, I can say that TI's programmers have paid very close attention to detail. All of their programs use the function, arrow, and editing keys right where you'd expect them. Escape gets you out of one menu into the previous one. The editing keys even work in MS-DOS: using Ins and Del, you can insert or delete a character within a command. The line under consideration changes color to remind you you're working on it. The same function key does the same thing through all of the voice-command routines. The menus are all tree-oriented, but there aren't more than two levels to the bottoms. The menu items do what they say they will—without much jargon.

"Like it? I may go hoarse praising its good points. It quietly does what it says it will, with accurate sample screens in the manual."

Phone Dialer

"I haven't experimented with the phone dialer much. The software looks good and does dial the phone. You can set it up to dial someone and play a prerecorded message. Once you run 'PCSpeech smartphone,' you can use the TI keypad, the phone, or your on-line list of numbers to dial out. There's also a way to continue working on the computer when you're put on hold. You can take notes on the computer while phoning, too."

Appointment System

"Nicely done. You can set the alarm to remind you to leave or expect someone. You can set up 'day at a glance' appointment lists days in advance. I don't think you can set daily or weekly appointments, except one at a time. Nonetheless, the overworked man without a secretary might find this essential."

The Phone Slave

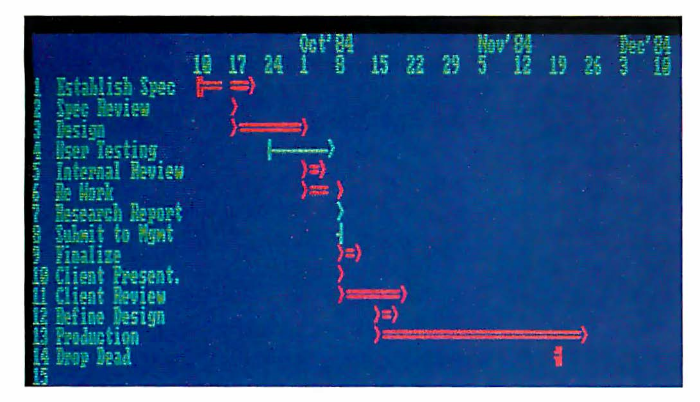
"I've now played with the answering-machine function for about an hour. (The biggest problem was my plugging the phone into the modem instead of the speech board!) It's easy to learn; everything is menu-driven and consistent. You record your phone greetings (up to five) and can then set the machine to answer with one of these. You can also replay messages from any Touch-Tone phone. For privacy, you can set up a four-digit password. Once you've convinced the computer that you're entitled, it will let you play back, delete, and skip over messages. It differentiates between old and new messages—and remembers when they came in. There was serious attention paid to detail in this program.

"Complaints: speech quality (again). The recorded messages tend to distort. The TI's voice itself is very clear, though. Other complaints: the machine takes several rings to answer the phone, even set to answer on the zeroth ring, and it takes several seconds to hang up after you hang up. But these are probably features: almost no one is actually ready to talk until the second ring, and you wouldn't want to hang up too early on anyone. There is no provision for remote voice command—you must use touch tones—nor can the many commands be listed over the phone. You'd have to carry the supplied reference card. You can't record new messages, switch messages, etc.,

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remotely. August 15, 12:05 a.m. is replayed as "zero eight one five at zero zero zero five"—the speech board's vocabulary should include the months, the numbers from 1 through 20, and a.m./p.m.

"Don't get me wrong: I like this product. TI could have left the phone-answering option off, with its attendant circuitry, but didn't. I'm glad; it's as good as some mechanical answering machines and doesn't limit the caller to a 15-second "HellothisisDave I'mtryingtoreachyou bye!"

Thoughts for Improvement

"The speech program should display the length (in bytes and seconds) of each piece of dictation. I don't like its green display (everything else is white on black), but that's minor.

"Playing with this board prompted many ideas. For instance, how about a software overlay that plays back dictation while in another program? That way, I could replay my meanderings and type them in with WordStar at the same time. A really smart program could find the space between words, play back one word at a time, and watch for the space bar to be pressed. You could listen to a word at a time and never have to fiddle with a foot control as with a regular dictating machine. Of course, it'd also have to wait for you when you made corrections. Hmm, maybe it could watch for the arrow and editing keys. When it saw one, it could wait for you. Then you'd signal start-up with something like Alt-Space. Oh, and it should repeat the word if you don't type anything for a while or press a Replay key.

"Listening, TI?"

The Modem

"The modem and speech software are somewhat integrated but leave room for improvement. The modem itself seems to work well. You can hook your phone through the modem and speech boards and still use the instrument. An integrated speech/modem board would be the next logical step.

"Another integration I'd like to see is using the network software (e.g., Omninet) to send voice messages from TI to TI."

TI Software

"We also received some TI-specific software. The WordStar uses all the special keys, including all 12 function keys. Other niceties: Shift-right-arrow moves by word, Shift-up-arrow by screen, etc. This is very intuitive for most people and much easier to remember than control keys.

"The MBASIC seems pretty standard. I haven't experimented with it.

"Emulate, a supplied utility, makes the TI much more like an IBM PC. You can run My Word! with it installed. It's not perfect—StarFleet Battles (com-

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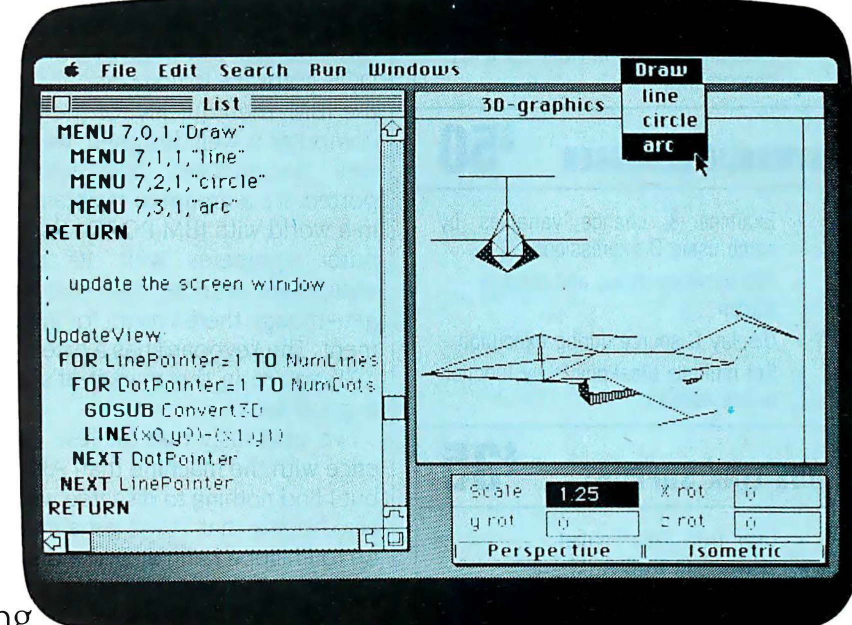
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piled IBM PC BASIC) still won't run. Emulate doesn't seem to affect the operation of TI-specific programs, so I run it at boot-up.

"IUS's EasyWriter II is also supplied and runs, but I didn't experiment much with it.

"The major defect of all the supplied software is the same: none of it supports PC-DOS and MS-DOS pathnames. You can change drives but not directories."

The Last Roundup

"The TI Professional deserves better than it has gotten. A lot of people own and use it: enough that most MS-DOS software is first announced for the IBM, then quickly for the TI. The computer is well designed, well built, well documented, and well supported. It's a dream to maintain. Even in a world with IBM PC ATs, this computer competes well. Its speech equipment is more than just a gadget—though there's room for improvement. The keyboard has a nice touch.

"If you're in the market, it's worth a good look."

I've obviously had far less experience with the machine than Alex has, but I find nothing to disagree with. I'm also hoping that TI will get a machine up to Philippe Kahn at Borland so that he can get Sidekick running for it.

Winding Up

The game of the month is Victory Games' Gulf Strike, a simulation of action in the Persian Gulf. We have the Atari disk version. It's strategy rather than arcade, though you use the joystick to select, move, and attack. The computer sets up the dozens of pieces so you don't have to—a major complaint about board games. Gulf Strike is for two people or the computer will play one side.

I think I might become fond of Avalon-Hill's implementation of Diplomacy for computers (A-H and Victory Games are sister firms located in Baltimore and New York, respectively); but the game can be played *only* on a machine with color, and it needs a lot of memory. However, you can even play solitaire, and if there are missing players, the computer can act for them. I've mixed emotions here; there was something satisfying about writing orders on little slips of paper and chunking them onto the board, and I don't get quite the same feeling from typing them in. Ah, well. If you don't have a gamesmaster, the A-H computerized version of Diplomacy can save a lot of quarrels.

There is no book of the month. What with everything else, I didn't read any computer books (other than my own).

Meanwhile, I'm piling up data for my big article on the future of BASIC (I'm beginning to believe it has a great future); starting my Modula-2 book; and encouraging Alex to work on an introductory-level Pascal book keyed to Borland's Turbo Pascal.

I'm also hoping to do some real work on my accounting program and minimum database, adding lots of help files and getting it running on the IBM PC. I'll be working with several BASIC dialects; doing practical programming like that is the best way to get a basis for comparison.

I have an interesting-looking program called Expert-Ease that claims to generate expert systems. I've much interest in expert systems. At the BYTE Show I was shown another such program, too, so when I get it I'll be able to compare them.

Also at the BYTE Show, Diversions Inc. gave me a special ribbon for my Macintosh Imagewriter printer. You make up any MacPaint image, then flip it left to right. You install this ribbon (it's called, appropriately, Under Ware) and insert a sheet of bond paper, print your MacPaint file, and out comes an iron-on suitable for transfer to a T-shirt. The possibilities stagger the imagination . . . ■

Jerry Pournelle welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE Publications, POB 372, Hancock, NH 03449. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply.



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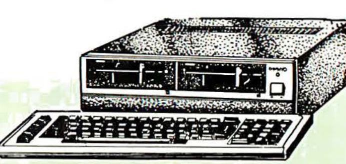
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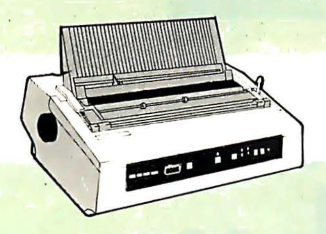
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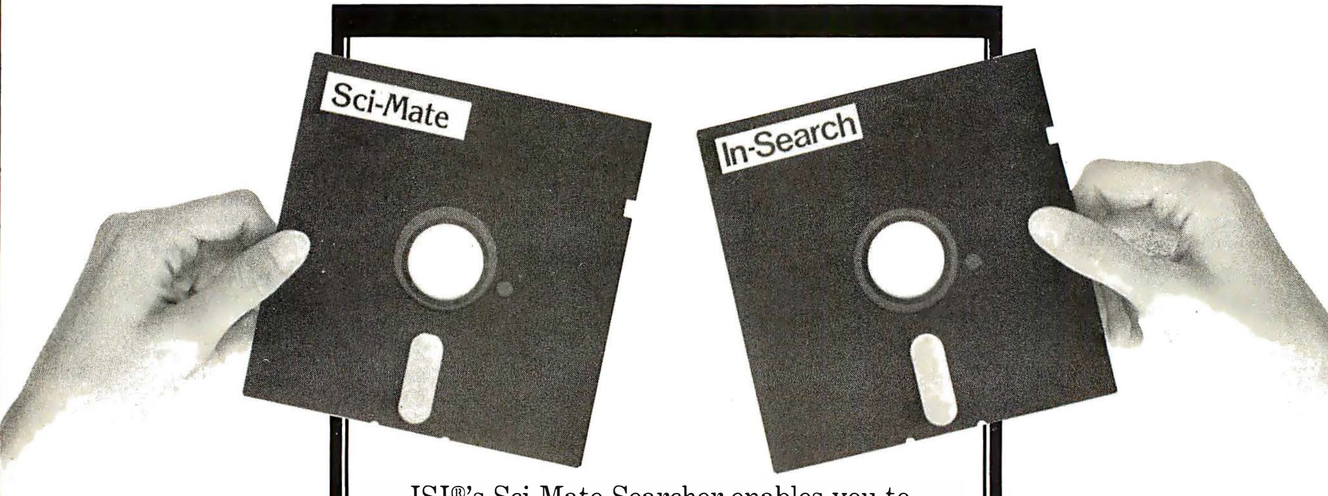
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Definite Disagreements

Dear Jerry,

The bias you've shown lately (perhaps always) against so-called "user-friendly computers and computer interfaces" seems to have at bottom an intense desire for all present personal computers to have an almost Marxist efficiency and no room for creativity. Being one of the elite reviewers with unlimited access to freebies, I guess you can afford to support any expensive computer (especially if it runs Pascal or UNIX). But do be honest: who pays for all this stuff you review and seem to have an endless affair with? The people with the big bucks, of course!

Have you taken a look lately at who buys the fancy equipment you so eagerly espouse (especially when CompuPro or Sage bend over backward to make sure your demos are always up to snuff and hang the cost in office visits)? Surely you don't think most people with incomes under $20,000 can afford the cream of the crop or would want to buy it for what? Small business, you say, is where it's at. Well, if business is the only useful purpose for a personal computer, then I wouldn't have it. Workaholics can have all the multiuser business computers they want. They won't find happiness in a personal computer. UNIX on a micro, even at 10 MHz and with a 20-megabyte hard disk, is painfully slow and klutzy at word-processing and accounting programs when accessed simultaneously by several users.

Obviously, you have no use for innovators such as Apple or Osborne. Their systems have the clear stigma of being popular computers, alas. Bugs are easy to spot in new systems under $3000. If only more people could afford a classy AT&T computer, but then again AT&T isn't making another Lisa. (This is debatable, as the starting price of Lisa I was $10,000, and the available software was about the same then—not very much.) For about a third of what an AT&T development system costs, a Lisa 2/10 can run UNIX and a host of other software, including MacWorks.

I would be careful about referring to dedicated Macintosh users as Mactribesmen or other Macnasties. They might decide you were unfunny and quite boring (as the genre goes—enough is enough). A sage such as Pournelle should stick to sci-fi writing instead of out-of-date computer reviews.

There is enough merit to MBASIC to resist the likes of any BASIC hater as yourself. BASIC may not be structured like Pascal, but it's a lot less tiring to look at than "PROCEDURE, BEGIN, END," ad nauseam. An English-like language would be better than BASIC, but so far natural languages have shown no popularity and ergo no large users group has evolved. FORTH is still a lot harder to master than BASIC.

Perhaps you would care to elaborate on MBASIC's bugs, if any exist in the Macintosh version. I haven't seen any, short of a few omissions from the version Radio Shack uses. MSX BASIC, as used by David Ahl, runs exactly as shown in recent issues of *Creative Computing*, when converted to Mac's MBASIC. The only difference is one of scaling. The high resolution of the Mac screen must be mapped to take advantage of BASIC's graphics commands.

It is going to take a lot more ingenuity to discover truly useful tasks for a personal computer to accomplish to be an actual friend and not an expensive sideline or sounding board. Bellyache as you will about present deficiencies, the real challenge is still *magic*. If you can do something you only dreamed about on past computers, the Mac dream will have become worth the song. Print this as it is if you dare.

Terry W. Gintz
Berkeley, CA

Like, wow, man, whose column have you been reading? Surely not mine.

1. I have never had an "office visit" from Sage, which, incidentally, is a company started literally in a garage by Rod Coleman and a couple of friends on a shoestring; it's hardly "big business." As to Tony Pietsch's visits: eight years ago I borrowed $12,000 in order to get enough to have Tony, then a graduate student, build Ezekial, my friend who happened to be a Z80 computer.

Perpetual maintenance wasn't in the contract, but Tony takes pride in his work and likes to see his creations run; one reason why he doesn't install computers any longer. Now he comes here mostly out of friendship; certainly not for any big bucks.

2. I have never advocated multiuser systems. Pournelle's rule is "One user, at least one processor." That's one reason I like the CompuPro 10: it has five processor chips for four users, and each user has his own block of memory. I thoroughly agree that the multiuser UNIX systems I've had access to have been too slow for me to write with.

3. I wrote one of the first favorable reviews of the Osborne. Well before the machine came out I did an unpublished critique of the Osborne I for Dr. Osborne. I believe Adam greatly and beneficially changed this field. Incidentally, the Osborne I cost more, in constant dollars, than the Sage II costs now; and Osborne Computer Company had far more financing and was much larger than Sage.

4. Alas, a usable Macintosh is not a system for under $3000. Anyway, I've said enough on that subject. I like innovations; but am I not obligated to tell the truth as I see it?

5. I am sure some people find my writing dull. Fortunately, most don't. And if I don't get my novel done pretty quick, you'll get your wish: my publishers will insist that I stick to science fiction (most SF writers do not much care for the cutesy sci-fi label).

6. You must surely be the only person in the universe who believes me a "BASIC hater." I've been enough through that war. Certainly "FORTH is still a lot harder to master than BASIC"; who ever doubted it? FORTH enthusiasts say it's worth the extra effort. They may be right; alas, I've never taken the time to master FORTH.

7. The version of Microsoft BASIC we had is not the version you get now; and the new 2.0 Microsoft BASIC for the Mac has lots of nifty new features.

8. I believe that most programs in future will be written by users, just as most books are written by readers. A professional writer is someone who can make a living at writing—and writing is

(continued)

definitely not *a full-time occupation. I believe that will soon be true of programming. When the user can think of something to make the machine do, and cause the machine to do it, we'll start getting the programs you want.*

9. "Dare"? I don't know if the editorial people in New Hampshire will print your letter or not, but if not, it won't be from fear of you by either them or me. Contentious letters that generate long replies don't often get published simply on grounds of space; and you are so thoroughly misinformed about me that I wonder if you have read anything other than a few random paragraphs from a single column. Stay well.—Jerry

NOT A TOY

Dear Jerry,

Before I get to the fire and sword, I have to say that an open, say-it-the-way-you-feel-it article makes a terrific escape from BYTE's usual earthy technical submissions. Your column is the best there is for opinion.

I just hate it when circumstance makes you look foolish. I have no doubt that your July Macintosh attack would have been toned down if you had written about it in July. The Mag Lag between submission and print date must be at least three months. As an example, I was shocked to find out from you that Microsoft was pulling Macintosh Multiplan out of distribution. Only later did I realize that you were talking about the conversion from version 1.1 to 1.2. Your single disk-copy-swapping problem has been eliminated from two fronts. There is now a utility to copy an entire disk in only four swaps, and the Finder's standard copying capabilities have been sped up tremendously. Mag Lag might not be a problem if technology were not changing monthly. How about dating your column each time you write it?

I should say that I was pleased to note that you are more fond of Macintosh than you might realize yourself. After reading your scathing review, I suddenly noticed in your other columns what computers you were comparing Mac to. You say that the $15,000 Lilith has better graphics. Well, I should hope so, and the same goes for AT&T's $10,000 (bare-bones) 3B2/300. You even made mention of a Japanese color-drawing program similar to MacPaint. Why all the comparisons if you don't regard Mac as a serious machine?

I think the descriptor I hated the most was "toy." Your definition of toy must be incredible praise, but most regard it as an insult. You say that Mac was fun to play with, but it was slow and that there is no software for it. I have to admit that disk access is terribly slow, but the 512K-byte upgrade (which your column ignored) will let it be a real computer. The "lack of software" problem is more of a "wait for software" problem. What exists now and what's coming are fantastic! Toy is only appropriate in the sense that Macintosh is fun! You undoubtedly enjoy your computers, but you have never called even your earliest 8080 computer a toy. I have seen a 6-year-old girl go to town on MacPaint, and her technophobic mother fell in love with MacWrite, and they had never seen a computer before. Now that hackers can find all the crazy computer designs they could ever want, real live human beings can get their benefit from computer technology.

I'll stick up for my Mac because you're too far away in the past to hear it talk. With an effective 6-MHz clocked 68000 and optimized ROMs, Macintosh is a tough cookie to beat. Lots of available software is not a matter of "maybe" but "when." Macintosh may be a slow starter, but it has what no small computer that exists today has: potential. In that respect, Macintosh is just about to break the ribbon.

KEITH NEMITZ
Flagstaff, AZ

Well, there is a matter of cost-effectiveness here. A full-up Mac with a second drive and the 512K-byte memory upgrade is not going to be cheap; indeed, I think you can buy a Sage II with the TPI color-graphics board and the Modula-2 operating system (complete with mouse) for about the same price. Of course, the Sage with Modula-2 won't have so very much software when it first comes out; but given Modula-2, that certainly will be a matter of "when," not "if."

I wish Apple and the Macintosh well, and if you've detected in my columns a willingness—yea, even a desire—to be fond of it, you're right. I just wish the implementation were up to the expectations.—Jerry

MACPRAISE

Dear Jerry,

In your July column, you miss what I consider essential about the Mac: good-bye commands and syntax; hello icons!

I can understand that you were impressed by AT&T's display, but after getting acquainted with the Mac's presentation of what computing should be like, I hope to never have to go back to an operating system, no matter how full of utilities and packages, where the burden is on me to remember what to say at the appropriate moment and how. In this respect, I think UNIX is particularly weak: for all its power and its bright ingredients, it is a messy system, with more than 400 commands with cryptic names l ke "troff" instead of "print," directories inside directories, complex punctuation in command lines, and redundancy of function.

With nothing but Apple's introductory software and a single disk drive, my roommate and I have been using our Macintosh not as a toy but as a workhorse, for everything that used to be done on a typewriter: homework, term papers, a journal article—even a set design, using MacPaint! In fact, the prime application I have in mind for it is to write my doctoral dissertation in biomathematics (no consortium deal: list price!), and even though the final document will run into at least a couple of hundred pages, I foresee no problem in editing and printing the whole thing: I wouldn't write it in a single block no matter how much memory I had.

None of this requires "yet another" compiler-compiler, line-oriented editor, or what have you. If I were given a system with half a dozen text editors, like UNIX, I would try them all and end up using one, so why should I pay for the redundancy? My hunch is that UNIX will prove difficult to sell to the office and the individual. It would have been great a year or two ago, but it came out too late.

FRANCISCO JOSÉ OYARZUN
Los Angeles, CA

You're certainly not alone in your views of UNIX. On the other hand, real UNIX has some wonderful utilities, like sorting, indexing, and table of contents generators, hidden in among all the cryptic yacc and yaloe nonsense.

On Mondays and Wednesdays I think UNIX will sweep the world. On Tuesdays and Thursdays I agree with you. It's midnight Monday just at the moment . . .
—Jerry

PROPRIETARY OPERATING SYSTEMS

Dear Jerry,

I have written an entire database system for the local Chamber of Commerce, but it is, alas, in Pascal. The reason: the machine they bought was the luxurious Corvus Concept. As you know, it is an

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elegant machine but not well supported by outside software. I found that all the database systems that were installed under its proprietary operating system were severely lacking in the facilities that I need to develop my system. I realized that despite its many shortcomings and bugs, I had been spoiled by dBASE II and expected other systems to offer the same facilities. I wouldn't settle for less for my client, so I went to a high-level, standard language.

The dangers of proprietary operating systems—yes, they fit the machine and make it shine, but there's not enough competition to inspire really good software. After all, it is this competition for the mass market that made micros succeed despite their price/performance ratio being less than mainframes. I don't care how good that ratio is, if the machine can't be made to do exactly what the user wants without hiring a staff of programmers, the one with the software wins.

Ben Smith
Smith Design
POB 80582
Fairbanks, AK 99708

My father once owned radio station KFRB in Fairbanks, but I've been there only once; it was cold with lots of snow.

Proprietary operating systems can help improve the breed, but companies that go that route often regret it. I can't help thinking that the Corvus would be a much more popular machine if it ran CP/M-68000. It sure is pretty.

Is your database likely to be for sale? I should imagine other Corvus owners would be interested.—Jerry

Apple Strategy

Dear Jerry,

I am writing in regard to your comments in recent months concerning the Macintosh. The recent change in the title of your column is, perhaps, symbolic of changes in the microcomputer industry. You are no longer a typical "user" but in fact an expert by today's standards. This change is also typified by the Macintosh. It is aimed at people who don't have the background that the industry has taken for granted in the past, a background shared by you and me. This means that everyone can use computers to some extent, but it also means that machines will not in the future be pushed to the limits of what the physical hardware can do. The usefulness of this machine to us "expert users" will not be negligible in the case of the success of Apple's gamble. However, its usefulness to the "real users" is not going to be vastly improved by that success either.

I can't say that I agree or disagree with your comments overall. Perhaps I could best say that I agree with your analysis but disagree with your opinions. I think Apple is, indeed, trying to put together a success story by the method of self-fulfilling prophecy. I agree that it is a skillful advertising technique that has allowed Apple to market a machine that is for all present intents and purposes useless to sophisticated users. However, I don't necessarily think that, as you implied, this is a bad thing.

While somewhat unfair to initial customers, especially somewhat sophisticated ones, the cart-before-the-horse technique is a calculated gamble that, if successful, will put equipment and software in the hands of the public that not only could not have been purchased for the price otherwise but wouldn't have been available at all. The important point is not whether Macintosh owners are getting their money's worth. Rather, it is a question of whether they will get their money's worth.

If Apple wins this gamble on the Macintosh's success, then there presumably is no problem. While I don't feel that ends justify means, it seems that the means are justified in this case by the fact that nobody can really lose (except Apple, and that is somewhat unlikely). Certainly it seems at this fairly early point that the Mac will in fact take off, in which case owners of the machine are way ahead. And if not, they still have a machine that will be useful for the purposes for which they purchased it (read: MacWrite and MacPaint).

Lowell Gilbert
Troy, NY

I find little to disagree with. I, too, want the Macintosh to succeed.

On the other hand: given the price and the limits, what we have is a machine that is easy to learn and not so easy to use. Perhaps the naive user will not know this and thus be satisfied. I rather hope so. What I fear, though, is that after a few weeks the Macintosh owner will regret buying a computer, so that the whole computer movement is set back.

All this will be moot if we get programs—and in particular, languages—for the Mac in the near future. The languages are not for "the rest of us," but so that semipro hackers, like me, can quickly turn out software for the machine. I know

you're supposed to be able to use a Lisa to write for the Mac, but I greatly prefer to develop software on the machine it's intended for.

I'm told that Philippe Kahn has decided to do Turbo Pascal for the Mac. I sure hope so; that will do wonders for the little beast. Meanwhile, I write letters, complete with fried egg, with mine; but I find the CompuPro and the IBM PC more useful for day-to-day work.

Incidentally: I don't think I'm an expert at all. I still use these machines. One thing I use them for is to write programs. I find programming easier—but more tedious—than writing books, and as programming languages get more powerful, programming gets easier. That's not expertise, just experience.—Jerry ■

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6809 XASM	99.50	500.00	99.50	99.50	99.50
8748 XASM	99.50	500.00	99.50	99.50	99.50
8051 XASM	99.50	500.00	99.50	99.50	99.50
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8085 XASM	99.50	500.00	99.50	99.50	99.50
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Happenings

IBM and networks, Concurrent PC-DOS, and other developments

BY JOHN MARKOFF AND EZRA SHAPIRO

It's certainly been a busy season for IBM—a network cabling standard, price cuts on the PC, a new keyboard for PCjr, the introduction of the AT, a network from Sytek, a carload of new software in all areas, and finally the announcement of the acquisition of Rolm, the innovative telecommunications company. If you take these developments one by one, they're all interesting, but not riveting. If you add them up, however, it becomes rather easy to launch into wild speculation on the fate of the personal computer industry. Immediately following the Rolm news, the grapevine has been awash with just such speculation, and a fair amount of gossip that verges on conspiracy theory.

The items about Sytek and Rolm products that appear later in this month's column were originally written with no knowledge of IBM's plans to move into communications in a major way. We saw the Rolm story as a fascinating new direction but certainly not an overwhelming trend, and we wondered parenthetically whether IBM's 23 percent stake in Rolm was a signal to AT&T that IBM was going to invade that corporate giant's territory, just as AT&T's foray into computers had been a challenge to IBM. As we write this, the details of IBM's Rolm takeover arrangements have been made public, but full stockholder (and legal) approval is still pending. While IBM's intentions have become clearer, the final outcome still is unsettled as of this writing. (Such are the problems of dealing with breaking news stories on the deadline schedule of a monthly magazine such as BYTE.)

Are the Rolm computer products, the Cedar and the Juniper, now to be seen as IBM products? Will they bear the blue IBM logo? Will the BIOS ROM, developed to be "PC-compatible" by Rolm engineers, be replaced with the true IBM chip? Will there be other changes to either IBM or Rolm microcomputers? We don't know yet, but we do know that the show is going to be worth watching.

—Ezra Shapiro, BYTE West Coast Bureau Chief

COMMUNICATIONS INTEGRATION

Rolm Corporation will be announcing a couple of new products intended to round out its line of office communications equipment, both of which integrate sophisticated telephone features with data-processing power for individual users in the form of IBM PC-compatible computing. Though the two devices must be used in conjunction with Rolm's CBX computerized switchboard system and as such are in no way single-user machines, they do indicate one of the important directions in which the microcomputer revolution is spreading.

The high-end product, called the Cedar, is a full system in itself. Like the mythical centaur, a creature that was half man and half horse, the Cedar is a blend of two existing technologies; it's both computer and telephone. Physically, the device is a compact workstation with a footprint somewhat smaller than that of the IBM PC. The base of the unit houses two 360K-byte disk drives and the system's electronic guts. Rising from the top on the right side is an angled monochrome monitor (a 9-inch diagonal green-phosphor display that operates in both text and graphics modes, much like the Compaq computer); on the left, there's a standard telephone handset. A detachable keyboard tucks into an opening under the drives.

The computer portion of the product is an IBM clone, running an 8088 microprocessor with 512K bytes of RAM (random-access read/write memory) standard. The telephone part is Rolm's high-tech telephone that can handle from one to four separate lines on one twisted-pair cable. Since the telephonic part of the system is digital for both data and voice, the unit has no need of an internal modem. (Any conversion of digital to analog signals takes place at the CBX level to interface with the outside world; within a Rolm system, all transmission is digital.)

The Cedar comes with a package of personal communications software that loads *over* the operating system and remains resident in 128K bytes of RAM. The software

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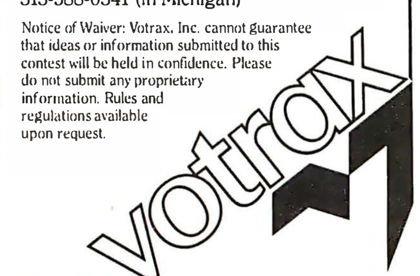
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IBM's decision to go with a medium-speed broadband LAN came as something of a surprise.

handles various telephone management functions, such as true electronic mail (both transmission and storage) with an on-screen alert, data sharing through the CBX, softkey control of telephone functions such as auto and repeat dialing, maintenance of a personal phone directory, and so on. Obviously, since the unit can control more than one line with no additional cabling, simultaneous voice and data transmission is easy. Product pricing is roughly equivalent to the sum of the component parts (computer, memory, software, phone) at $4995 for one unit, down to $4245 in quantities over 100.

The second product, the Juniper, is a stand-alone add-on to an existing IBM PC or compatible that links an existing computer to the CBX system and gives it all the features of the Cedar. It's a smaller box that looks much like a telephone; it connects to a card that plugs into an expansion slot in the computer. All the software previously mentioned comes with the package, and all the integration of the CBX system is made available to the workstation. It costs $1495 for one, down to $1360 in quantity.

The products represent a thorough solution to the problems of personal computing in a business installation. Users have all the advantages of individual desktop processing with full privacy, yet can use the telecommunications aspects of the system to share data with remote microcomputers, file servers or other storage devices, and even company mainframes. Though not a true local-area network, the system makes use of the features of the CBX to provide a more-than-adequate surrogate. In addition, the units provide full telephone capabilities.

Not only do the Rolm products make a lot of sense for a multiuser business environment, the solution is accomplished without the rat's nest of wiring that usually accompanies this much functionality.

THE IBM LAN

Now that IBM has spoken, the real question about the company's decision to offer a local-area network (LAN) configuration for its personal computer line is: Will the microcomputer industry be any closer to a standard in the LAN world?

IBM's decision to go with a medium-speed broadband local-area network came as something of a surprise to industry analysts who had been expecting a network that was more closely modeled after the "token ring" topology that had been discussed in recent IBM technical papers. However, IBM claims that there will a gateway between this net and any future network that they might offer.

In its search for its local-area network, IBM turned to an established broadband LAN manufacturer, Sytek Inc., of Mountain View, California. Sytek is located in a corner of Silicon Valley that has been affectionately dubbed "Coaxial Corridor" because, in addition to Sytek, Ethernet manufacturer 3Com and several other network companies are all based within easy cabling distance of each other.

Sytek has been marketing its own network, a product called LocalNet/20, that is used by both large corporate and government installations and by a number of college campuses as well. In the Sytek system, each user is connected to a broadband cable through a network interface device. Each of these devices has its own microcomputer and a broadband modem that converts digital data to an analog frequency-modulated form for transmission across the network. LocalNet uses frequency division multiplexing to define as many as 120 separate channels that can share each network.

Sytek also has been working on an ongoing cable television project called MetroNet in conjunction with the Gerald Division of General Instru-

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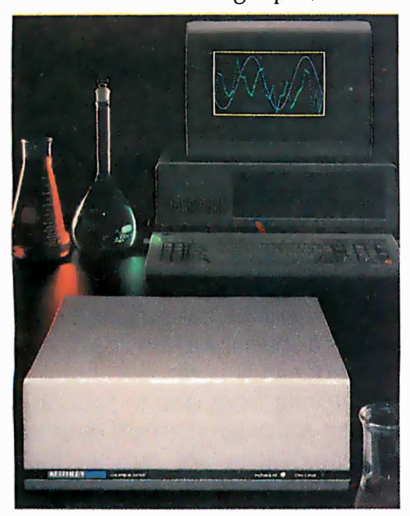
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VISA

The most intriguing aspect of the IBM LAN is the potential to support video and voice across the network.

ments. This is a broadband communications network that will use cable television networks as its medium. MetroNet is designed to bring videotex services, as well as conventional television programming, to residential and business subscribers.

According to Gregory Ennis, director of systems engineering at Sytek, the IBM PC Network has been designed to conform to LocalNet architecture. In practice, this means that the IBM version will use standard 75-ohm CATV (cable television) coaxial cable and connection hardware. The Network itself will be a 2-megabyte Carrier Sense Multiple Access with Collision Detection (CSMA/CD) broadband network. It will consist of a Network Adaptor for each PC, a Network Translator Unit (a stand-alone unit that is designed to provide single-channel frequency translation for the network), and cabling hardware.

The Network Adaptor card, which will plug into IBM PCs, XTs, Portable PCs, and the new PC AT, contains a Network BIOS (basic input/output system) in ROM (read-only memory), its own on-board microprocessor, and an RF (radio frequency) modem that broadcasts onto the network. Each card is given its own unique 48-bit network identifier and provides support that allows each individual PC to be booted from the network, making networks of diskless PCs and a single disk server possible.

The most intriguing aspect of the Sytek LAN is the obvious room for growth—particularly the potential to support video and voice across the network in the future. Also worth mentioning is the capability of each Network Adaptor card to support up to 32 sessions simultaneously. Thus, as PC-DOS moves closer to a true multitasking architecture it is possible to conceive of an individual PC with the capability of connecting to one or several mainframe hosts and carrying out other LAN-based tasks such as access to files or a distributed database.

Finally, we note that IBM rudely shut the PCjr out of the PC Network. In saying that the PCjr won't be supported on the first LAN to be offered, is IBM giving us some sort of a broader hint on the future of the PCjr?

However, despite IBM's alleged power to make any decision a de facto standard, most existing network manufacturers have shown no signs of abandoning their own network products and insist that they still offer more performance and value than IBM does. Perhaps this announcement was just not compelling enough to pull the rest of the industry along in IBM's wake.

A Different Approach

If your local-area networking needs aren't quite as extensive as the capabilities offered by the new IBM PC Network, or if you have the vision of your personal computer controlling a variety of functions around your house or office, you might be interested in hearing about the Power Line Network (PLN) from Mollard Systems Design in San Jose, California. Mollard has recently announced a simple, low-cost network based on a stand-alone controller (developed around a bipolar controller chip from National Semiconductor) that connects to an IBM PC through an RS-232C interface and then directly to any standard 110-volt 60-Hz power outlet. The PLN network allows data transmission at 2880 bps (bits per second) for up to 254 individual network stations as well as a special A/D (analog to digital) converter PLN controller that allows monitoring from one to four analog inputs. Although the PLN data transfer capabilities are only of limited speed, the network does permit peripheral sharing. And because the network will support a large number of device controllers from BSR, it offers an inexpensive way to use an IBM PC

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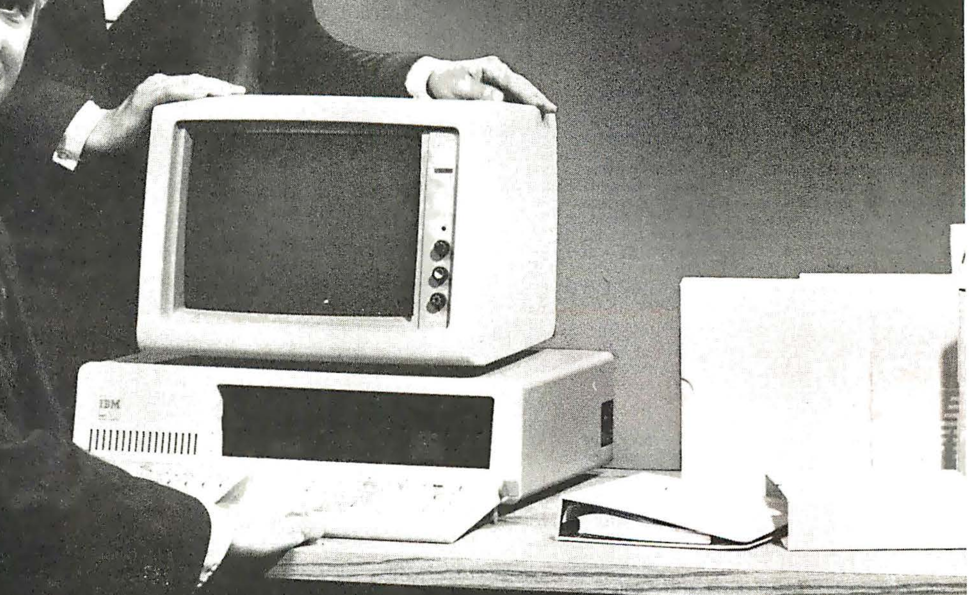
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MicroAge *franchisees* Ernie Venta *and* Elayne Kalman *shown with an* IBM *Personal Computer.*

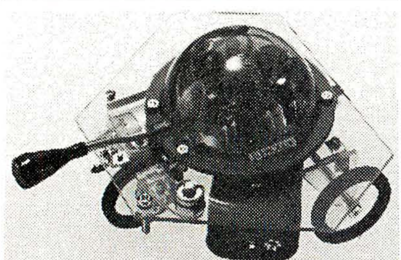
Circle 253 on inquiry card.

Circle 206 on inquiry card.

HAPPY HOLIDAYS!

OWI EDUCATIONAL ELECTRONIC ROBOT KITS!

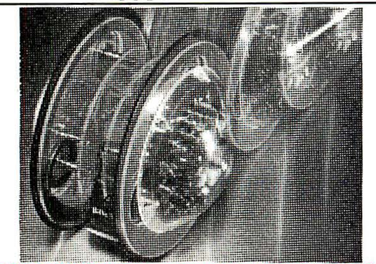
Clever, inexpensive robot kits feature pre-assembled pc boards, hardware & mechanical-drive systems that can be handled by anyone. Only basic hand tools required for assembly. OWI's *MOVIT* line provides innovative, affordable robot kits that entertain as well as educate.



PEPPY Sound/Touch Sensor Robot Kit

The PEPPY has a 2-way sensor that reacts to noise & solid objects in its path. When the front-located sensor comes in contact with an obstacle, or hears a loud noise such as a clap, it will automatically turn left. Contact with a solid object triggers reverse action and the PEPPY will turn 180° to the left and continue until another object blocks its way. **• Power source: 2 ea. AA batteries (not incl.) • Color: pink • Size: 4.75" Radius x 2.75"H**

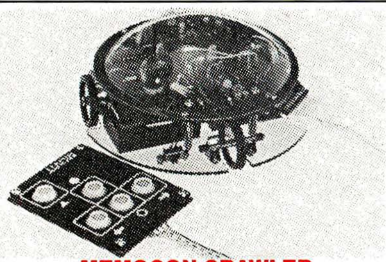
MV-916 Peppy............ $24.95



CIRCULAR Remote Control Robot Kit

The CIRCULAR model has 2 large wheels which roll this super robot left, right, forward, or around. All the movements can be perfectly controlled by a hand-held remote control box. **• Power source (main body): 3 ea. AA batt., 1 ea. 9V battery - (control box): 1 ea. 9V battery (not incl.) • Color: green • Size: 2.75" Radius x 5.75"H**

MV-935 Circular........... $69.95



MEMOCON CRAWLER
Programmable Memory Robot Kit

BUILD AN INTERFACE FROM MEMOCON TO YOUR PERSONAL COMPUTER!

This robot is memory controlled. It operates according to the program you input using the keyboard included with the kit. The keyboard has 5 mode switches: forward, right, left, pause, buzzer/light (LED). The CRAWLER employs a sequence func. static RAM 256x4 bit memory **• Movement: 3 wheels driven by 2 DC motors • Control: Memory/electronic circuit (thru the keyboard) • Element: 4-bit static RAM • 256 steps (no repeat steps) approx. 0.7-0.3 sec/1 step • Power source: 2 ea. AA batteries, 1 ea. 9V battery (not incl.) • Color: black • Size: 2.75" Radius x 2.5"H**

MV-918 Memocon......... $74.95

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12/84

User's familiar with either MS-DOS or CP/M can quickly feel at home with the new operating system, Concurrent PC-DOS.

for computerized control and security applications.

Mollard is offering three different types of controllers: a master PLN for the IBM PC, a controller PLN with a Centronics parallel interface for peripherals, and the A/D converter with provision for inputs with a voltage range between 0 and 5 volts.

According to Fred Louder, one of the designers of the Power Line Network, most small offices and homes have AC power supplies that allow PLNs to communicate. However, without special modifications the network will not extend beyond local transformers. (Common transformers are generally shared within most commercial and industrial buildings and by several houses in residential areas, but floors in large buildings are usually separated.) Although each network can be composed of a maximum of 254 PLNs, an additional security code in the network protocol creates the possibility of having many networks sharing the same power line.

Louder claims that previous attempts at using the local power supply as a network medium have encountered difficulties because they used AM (amplitude modulation) transmission techniques. The Mollard system uses FM (frequency modulation) instead, which makes the network insensitive to electrical noise on the power line. In fact, an earlier application of this technology was for built-in computer control of industrial lighting systems that eliminated the need for any additional wiring beyond the traditional power cabling.

The PLN network includes software that permits viewing of remote PC directories, unattended file transfer, and sending files to remote peripherals such as printers. A simple file-locking mechanism is incorporated into the network software to exclude unauthorized downloading or modification of existing files on a shared file system. The network controllers and system software cost $699 each. Currently only network software for the IBM PC is available; however, Mollard plans on extending the network to Apple II computers in the future.

A New DR Operating System

Concurrent PC-DOS, version 3.2, is another attempt by Digital Research Inc. (DR) to win back a chunk of the microcomputer operating-system market it lost when DR's CP/M line of products received a sound trouncing from Microsoft's MS-DOS and PC-DOS for 16-bit computers. As such, Concurrent PC-DOS raises more questions than it answers.

The new operating system, which was released at the end of September, should not be confused with Concurrent DOS, version 3.1, an earlier DR package, though both products are multitasking operating systems that allow you to create multiple display windows for running an assortment of programs simultaneously.

Older Concurrent DOS closely resembles its CP/M ancestors. Although it can run both MS-DOS and CP/M-86 software in individual windows, it retains CP/M's command syntax. The utilities that come with the operating system have familiar CP/M names like PIP and STAT, and the Concurrent DOS package includes an assembler, a debugger, software hooks for GSX, a graphics interface, and DRNet, a networking interface.

Concurrent PC-DOS is much more of a consumer product. It is designed to be similar enough to both MS-DOS and CP/M in command structure and name that users familiar with either system can quickly feel at home with it. It's also the first Digital Research operating system to include real applications software—a visually oriented address filer that closely resembles Hewlett-Packard's Personal Cardfile for the HP 150 (though with-

(continued)

7400

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74LS32	14	.39	74LS162	16	.69	74LS365	16	.49
74LS37	14	.35	74LS163	16	.69	74LS366	16	.49
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74ALS00

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MICROPROCESSOR CHIPS

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68B45	40	CRT Controller (CRTC) 2MHz	19.95
6850	24	Asynchronous Comm. Adapter	3.95
6860	24	0-600bps Digital MODEM	7.95
68000L8	64	MPU 16-Bit (8MHz)	39.95
68488P	40	General Purpose Int. Adapter	9.95

8000/80000 SERIES

Part No.	Pins	Function	Price
8031	40	Control Oriented CPU w/RAM & I/O	14.95
8035	40	MPU — 8-Bit	5.95
8039	40	CPU — Sgl. Chip 8-Bit (128bts. RAM)	5.95
8040N-6	40	CPU (256 bytes RAM)	9.95
8060	40	CPU — 8-Bit NMOS	14.95
8070N	40	CPU (64 bytes RAM)	19.95
8073N	40	CPU w/Basic Micro Interpreter	29.95
8080A	40	CPU	3.95
8085A	40	CPU	4.95
8086-2	40	CPU 16-bit 8MHz	24.95
8087	40	Arithmetic Processor	189.95
8088	40	CPU 8/16-Bit	19.95
8155	40	HMOS RAM I/O Port-Timer	6.95
8156	40	RAM with I/O Port and Timer	8.95
8205	16	Hi Speed 1 out of 8 Binary Decoder	3.95
8212	24	8-Bit Input/Output (74S412)	2.95
8224	16	Clock Generator/Driver	2.95
8228	28	System Cont./Bus Driver (74S428)	4.95
8237-5	40	High Perf. Prog. DMA Cont. (5MHz)	19.95
8238	28	System Controller (74S438)	4.95
8243	24	I/O Expander for 48 Series	4.95
8250N	40	Async. Comm. Element	10.95
8251	28	Prog. Comm. I/O (USART)	4.95
8251A	28	Prog. Comm. Interface (USART)	7.95
8253	24	Prog. Interval Timer	6.95
8255	40	Prog. Peripheral I/O (PPI)	4.95
8255A-5	40	Prog. Peripheral I/O (PPI) 5MHz	7.95
8259	28	Prog. Interrupt Control	5.95
8272	40	Sgle/Dble Density Floppy Disk Cont.	19.95
8274	40	Multi-Protocol Serial Cont. (7201)	29.95
8279	40	Prog. Keyboard/Display Interface	6.95
8282	20	Octal Latch	8.95
8284	18	Clock Generator/Driver	6.95
8286	20	Octal Bus Transceiver	7.95
8287	20	Octal Bus. Transceiver (Inverted)	7.95
8288	20	Bus Controller	19.95
8303	20	8-Bit Tri-State Bi-Directional Trans.	3.49
8304	20	8-Bit Bi-Directional Receiver	3.49
8310	20	Octal Latched Peripheral Driver	3.95
8741	40	8-Bit Univ. Peripheral Interface	29.95
8748	40	HMOS EPROM MPU	39.95
8749	40	MPU 8-Bit (EPROM Version of 8049)	39.95
8755	40	16K EPROM with I/O	39.95
80186-6	68	High Integration 16-Bit MPU	99.95

DISK CONTROLLERS

Part No.	Pins	Function	Price
INS1771-1	40	Single Density	16.95
FD1791	40	Single/Dual Density (Inv.)	24.95
FD1793	40	Single/Double Density (True)	26.95
FD1795	40	Dual Density/Side Select (Inv.)	26.95
FD1797	40	Dual Density/Side Select (True)	29.95

SPECIAL FUNCTION

Part No.	Pins	Function	Price
DS0026CN	8	Dual MOS Clock Driver (5MHz)	1.95
INS2651	28	Communication Chip	7.95
MC3470P	18	Floppy Disk Read Amp System	4.95
MM5321N	16	TV Camera Sync. Generator	9.95
MM54240N	24	Asynchronous Transmitter/Receiver	5.95
MM58167AN	24	Microprocessor Real Time Clock	8.95
MM58174AN	16	Micro. Compatible Time Clock	8.95
MM5369AA/N	8	Prog. Oscillator/Divider (60Hz)	1.79
MM5369EST	8	Prog. Oscillator/Divider (100Hz)	1.95

DYNAMIC RAMS

Part No.	Pins	Function	Price
1103	18	1024x1 (300ns)	.99
4027	16	4096x1 (250ns)	1.49
4116N-2	16	16,384x1 (150ns)	1.39 — 8/10.95
4116N-3	16	16,384x1 (200ns)	1.15 — 8/8.95
4116N-4	16	16,384x1 (250ns)	.89 — 8/6.95
4164N-150	16	65,536x1 (150ns)	5.19 — 8/40.95
4164N-200	16	65,536x1 (200ns)	4.95 — 8/38.95
MM5261	18	1024x1 (300ns)	.35 — 8/1.95
MM5262	22	2048x1 (365ns)	.10
MM5270	18	4096x1 (250ns) MK4096	4.95
MM5280	22	4096x1 (200ns) 2107	3.95
MM5298-3	16	8192x1 (200ns)	.59
41256	16	262,144x1 (200ns)	31.95

STATIC RAMS

Part No.	Pins	Function	Price
2101	22	256x4 (450ns) 8101	1.95
2102	16	1024x1 (350ns)	.89
2102-2L	16	1024x1 (250ns) L.P. (91L02)	1.49
2111	18	256x4 (450ns) 8111	2.49
2112	16	256x4 (450ns) MOS	2.49
2114N	16	1024x4 (450ns)	1.29 — 8/9.95
2114N-L	18	1024x4 (450ns) L.P.	1.95 — 8/13.95
2114N-2	16	1024x4 (200ns)	1.39 — 8/10.95
2114N-2L	16	1024x4 (200ns) L.P.	1.69 — 8/13.49
2147HN	16	4096x1 (70ns)	4.49
2148HN	18	1024x4 (70ns)	4.95
TMS4045	18	1024x4 (450ns)	3.95
TMS40L47-45	20	1024x4 (450ns)	1.95
5101	22	256x4 (450ns) CMOS	3.95
MM5257	18	4096x1 (450ns) 4044	4.95
HM6116P-2	24	2048x8 (120ns) CMOS	7.95
HM6116LP-2	24	2048x8 (120ns) L.P.CM	8.95
HM6116P-3	24	2048x8 (150ns) CMOS	4.95
HM6116LP-3	24	2048x8 (150ns) L.P. CMOS	6.49
HM6116P-4	24	2048x8 (200ns) CMOS	4.75
HM6116LP-4	24	2048x8 (200ns) L.P. CMOS	5.49
HM6264P-12	28	8192x8 (120ns) CMOS	37.95
HM6264LP-12	28	8192x8 (120ns) L.P. CMOS	39.95
HM6264P-15	28	8192x8 (150ns) CMOS	34.95
HM6264LP-15	28	8192x8 (150ns) L.P. CMOS	37.95
27LS00	16	256x1 (80ns) L.P.	3.95
7489	16	16x4 (50ns) 3101	2.25
74C921	18	256x4 (250ns) CMOS	5.95
74C930	18	1024x1 (250ns) CMOS (6518)	5.95
74S189	16	16x4 (35ns) 93405	2.95
74S289	16	16x4 (35ns) 3101	2.95
82S10	16	1024x1 (50ns) O.C. (93415)	3.95
82S25	16	16x4 (50ns) O.C. (74S289)	2.25

PROMS/EPROMS

Part No.	Pins	Function	Price
1702A	24	256x8 (1µs)	3.95
2708	24	1024x8 (450ns)	3.95
2708-5	24	1024x8 (550ns) SM00246	3.49
TMS2516	24	2048x8 (450ns) 2716	4.95
TMS2532	24	4096x8 (450ns) NMC2532	5.49
TMS2564	28	8192x8 (450ns)	10.95
TMS2716	24	2048x8 (450ns) 3 voltage	7.95
2716	24	2048x8 (450ns)	3.95
27C16	24	2048x8 CMOS	14.95
2716-1	24	2048x8 (350ns)	5.49
2716Q-5	24	2048x8 (550ns)	3.75
2732	24	4096x8 (450ns)	4.95
2732-20	24	4096x8 (200ns)	10.95
2732A-20	24	4096x8 (200ns) 21V	11.49
2732A-25	24	4096x8 (250ns) 21V	7.19
2732A-45	24	4096x8 (450ns) 21V	6.49
27C32A-30	24	4096x8 (300ns) 21V (CMOS)	22.95
2764-20	28	8192x8 (200ns) 21V	14.95
2764-25	28	8192x8 (250ns) 21V	7.19
2764-45	28	8192x8 (450ns) 21V	6.49
27C64	28	8192x8 CMOS 21V	22.95
MCM68764	24	8192x8 (450ns) 21V	24.95
27128-25	28	16,384x8 (250ns) 128K Eprom 21V	21.95
27256-25	28	32,768x8 (250ns) 256K Eprom (14V)	99.95
74S188	16	32x8 PROM O.C. (6330-1)	1.75
74S287	16	256x4 PROM T.S. (6301-1)	1.79
74S288	16	32x8 PROM T.S. (6331-1)	1.79
74S387	16	256x4 PROM O.C. (6300-1)	1.95
74S471	20	256x8 PROM T.S. (6309-1)	4.95
74S472	20	512x8 PROM T.S. (6349-1)	4.95
74S473	20	512x8 PROM O.C. (6348)	4.95
74S474	24	512x8 PROM T.S. (DM87S296N)	4.95
74S475	24	512x8 PROM O.C. (6340)	4.95
74S476	16	1024x4 PROM T.S.	6.95
74S478	24	1024x8 PROM T.S.	9.95
74S570	16	512x4 PROM O.C. (6305)	2.95
74S571	16	512x4 PROM T.S. (6306)	2.95
74S572	16	1024x4 PROM O.C. (6352)	4.95
74S573	16	1024x4 PROM T.S. (82S137)	4.95
82S23	16	32x8 PROM O.C. (27S18)	2.95
82S115	24	512x8 PROM T.S. (27S15)	9.95
82S123	16	32x8 PROM T.S. (27S19)	2.95
82S126	16	256x4 PROM O.C. (27S20)	2.95
82S129	16	256x4 PROM T.S. (27S21)	2.95
82S130	16	512x4 PROM O.C. (27S12)	3.95
82S185	16	2048x4 PROM T.S. (TBP24S81)	9.95
82S191	24	2048x8 (80ns)	14.95
DM87S181N	24	1024x8 PROM T.S. (82S181)	9.95
DM87S184N	16	2048x4 PROM O.C. (82S184)	9.95
DM87S185N	16	2048x4 PROM T.S. (82S185)	9.95
DM87S191N	24	2048x8 PROM T.S. (82S191)	14.95

DATA ACQUISITION

Part No.	Pins	Function	Price
DC10		Mostek DC/DC Converter +5V to −9V	2.95
ADC0801	20	8-Bit A/D Converter (1/4LSB)	14.95
ADC0803	20	8-Bit A/D Converter (±1/2LSB)	4.95
ADC0804	20	8-Bit A/D Converter (1LSB)	3.49
ADC0808	28	8-Bit A/D Conv. w/8-Channel Analog	9.95
ADC0809	28	8-Bit A/D Converter (8-Ch. Multi.)	4.49
ADC0816	40	8-Bit A/D Conv. w/16-Channel Analog	14.95
ADC0817	40	8-Bit A/D Converter (16-Ch. Multi.)	9.49
DAC0806	16	8-Bit D/A Converter (0.78% Lin.)	1.95
DAC0807	16	8-Bit D/A Converter (MC1408-7)	1.49
DAC0808	16	8-Bit D/A Converter (MC1408-8)	2.25
DAC0830	20	8-Bit Up D/A Conv. (.05% Lin.)	5.95
DAC0831	20	8-Bit Up D/A Conv. (.10% Lin.)	4.49
DAC1000	24	10-Bit D/A Conv. Micro. Comp. (0.05%)	7.95
DAC1008	20	10-Bit D/A Conv. Micro. Comp. (0.20%)	6.95
DAC1020	16	10-Bit D/A Conv. (0.05% Lin.)	7.95
DAC1022	16	10-Bit D/A Conv. (0.20% Lin.)	5.95
DAC1222	18	12-Bit D/A Conv. (0.20% Lin.)	6.95
DAC1230	20	12-Bit Up D/A Conv. (.05% Lin.)	14.95
DAC1231	20	12-Bit Up D/A Conv. (.10% Lin.)	13.95
AY-5-1013A	40	30K Baud UART (TR1602)	3.95

Low Profile (Tin) Sockets

Part No.	1-9	10-99	100-up
8 pin LP	.16	.14	.13
14 pin LP	.17	.15	.14
16 pin LP	.19	.17	.16
18 pin LP	.26	.24	.23
20 pin LP	.30	.27	.25
22 pin LP	.31	.28	.26
24 pin LP	.33	.30	.28
28 pin LP	.40	.37	.35
40 pin LP	.49	.46	.43

Soldertail (Gold) Standard

Part No.	1-9	10-99	100-up
8 pin SG	.39	.35	.29
14 pin SG	.49	.45	.39
16 pin SG	.55	.49	.45
18 pin SG	.65	.59	.51
20 pin SG	.75	.65	.59
22 pin SG	.79	.69	.65
24 pin SG	.79	.69	.65
28 pin SG	.95	.85	.75
36 pin SG	1.25	1.15	.99
40 pin SG	1.39	1.25	1.15

Wire Wrap Sockets (Gold) Level #3

Part No.	1-9	10-99	100-up
8 pin WW	.55	.49	.45
10 pin WW	.69	.65	.59
14 pin WW	.75	.69	.65
16 pin WW	.79	.72	.65
18 pin WW	.95	.85	.75
20 pin WW	1.19	1.09	.95
22 pin WW	1.29	1.19	1.05
24 pin WW	1.35	1.19	1.09
28 pin WW	1.69	1.55	1.39
36 pin WW	1.89	1.79	1.69
40 pin WW	2.29	1.95	1.79

Header Plugs (Gold)

Part No.	1-9	10-99	100-up
14 pin HP	.65	.59	.55
16 pin HP	.69	.65	.59
24 pin HP	1.15	.99	.89

Header Covers

Part No.	1-9	10-99	100-up
14 pin HC	.15	.13	.12
16 pin HC	.19	.17	.15
24 pin HC	.29	.25	.22

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Digitalker™

DT1050 — Applications: Teaching aids, appliances, clocks, automotive, telecommunications, language translations, etc.

The DT1050 is a standard DIGITALKER kit encoded with 137 separate and useful words, 2 tones, and 5 different silence durations. The words and tones have been assigned discrete addresses, making it possible to output single words or words concatenated into phrases or even sentences. The "voice" output of the DT1050 is a highly intelligible male voice. Female and children's voices can be synthesized. The vocabulary is chosen so that it is applicable to many products and markets.

The DT1050 consists of a Speech Processor Chip, MMS4104 (40-pin) and two (2) Speech ROMs MM52164SSR1 and MM52164SSR2 (24-pin) along with a Master Word list and a recommended schematic diagram on the application sheet.

DT1050 Digitalker™ .... $34.95 ea.
MM54104 Processor Chip .... $14.95 ea.

DT1057 - Expands the DT1050 vocabulary from 137 to over 260 words. Includes 2 ROMs and specs.
Part No. DT1057 .... $24.95 ea.

INTERSIL

Part No.	Pins	Function	Price
7045IPI	28	CMOS Precision Timer	14.95
7045EV/Kit	28	Stopwatch Chip, XTL (Evaluation Kit)	19.95
7106CPL	40	3½ Digit A/D (LCD Drive)	10.49
FE0203D		3½ Digit LCD Display for 7106 & 7116	14.95
7106EV/Kit	40	IC, Circuit Board, Display (Evaluation Kit)	46.95
7107CPL	40	3½ Digit A/D (LED Drive)	10.95
7107EV/Kit	40	IC, Circuit Board, Display (Evaluation Kit)	46.95
7116CPL	40	3½ Digit A/D LCD Dis. HLD	10.95
7201IUS		Low Battery Volt Indicator	2.25
7205IPG	24	CMOS LED Stopwatch/Timer	14.95
7205EV/Kit	24	Stopwatch Chip, XTL (Evaluation Kit)	16.95
7206CJPE	16	Tone Generator	4.95
7206CEV/Kit	16	Tone Generator Chip, XTL (Evaluation Kit)	7.95
7207AIPD	14	Oscillator Controller	5.95
7207AEV/Kit	14	Freq. Counter Chip, XTL (Evaluation Kit)	8.49
7215IPG	24	4 Func. CMOS Stopwatch CKT	16.95
7215EV/Kit	24	4 Func. Stopwatch Chip, XTL (Evaluation Kit)	19.49
7216AIJI	28	8 Digit Univ. Counter C.A.	31.49
7216DIPI	28	8 Digit Freq. Counter C.C.	21.49
7217IJI	28	4 Digit LED Up/Down Counter C.A.	10.95
7217AIPI	28	4 Digit LED Up/Down Counter C.C.	9.95
7224IPL	40	LCD 4½ Digit Up Counter DRI	10.95
7226AEV/Kit	40	5 Function Counter Chip, XTL (Evaluation Kit)	99.95

30009 1983 INTERSIL Data Book (1356p.) $9.95

74HC High Speed CMOS

74HC00	14	.59	74HC139	16	1.05	74HC245	20	2.59
74HC02	14	.59	74HC147	16	1.29	74HC251	16	.99
74HC03	14	.89	74HC151	16	.99	74HC253	16	1.09
74HC04	14	.59	74HC153	16	1.09	74HC257	16	.99
74HCU04	14	.69	74HC154	24	2.65	74HC259	16	1.69
74HC08	14	.59	74HC157	16	.99	74HC266	14	.89
74HC10	14	.59	74HC158	16	.99	74HC273	20	2.79
74HC11	14	.69	74HC160	16	1.39	74HC280	14	4.59
74HC14	14	.89	74HC161	16	1.39	74HC299	20	5.59
74HC20	14	.59	74HC162	16	1.39	74HC366	16	2.59
74HC27	14	.59	74HC163	16	1.39	74HC367	16	2.59
74HC30	14	.69	74HC164	14	1.35	74HC373	20	2.69
74HC32	14	.79	74HC165	16	2.15	74HC374	20	2.69
74HC42	16	1.09	74HC166	16	2.49	74HC390	16	1.59
74HC51	14	.89	74HC173	16	1.29	74HC393	14	1.59
74HC58	14	.89	74HC174	16	1.09	74HC533	20	2.69
74HC73	14	.79	74HC175	16	1.09	74HC534	20	2.69
74HC74	14	.79	74HC190	16	1.59	74HC595	16	3.19
74HC75	16	.99	74HC191	16	1.59	74HC688	20	3.59
74HC76	16	.79	74HC192	16	1.49	74HC4024	14	1.75
74HC85	16	1.69	74HC193	16	1.49	74HC4040	16	1.49
74HC86	14	.75	74HC194	16	1.19	74HC4060	16	1.49
74HC107	14	.79	74HC195	16	1.19	74HC4075	14	.59
74HC109	16	.79	74HC221	16	2.95	74HC4078	14	.59
74HC112	16	.79	74HC237	16	1.49	74HC4511	16	1.95
74HC123	16	2.29	74HC240	20	2.29	74HC4514	24	4.19
74HC125	14	1.75	74HC241	20	2.29	74HC4538	16	2.59
74HC132	14	1.29	74HC242	14	2.15	74HC4543	16	3.75
74HC137	16	1.59	74HC243	14	2.15			
74HC138	16	1.19	74HC244	20	2.29			

74HCU04 is unbuffered. All others are buffered.

74C—C/MOS

74C00	14	.29	74C107	14	.79	74C240	20	1.95
74C02	14	.35	74C151	16	2.19	74C244	20	1.95
74C04	14	.35	74C154	24	3.25	74C373	20	2.29
74C08	14	.35	74C157	16	1.75	74C374	20	2.29
74C10	14	.35	74C160	16	1.19	74C901	14	.59
74C14	14	.59	74C161	16	1.19	74C902	14	.79
74C20	14	.35	74C162	16	1.19	74C903	14	.59
74C30	14	.35	74C163	16	1.19	74C906	14	.59
74C32	14	.39	74C164	14	1.29	74C907	14	.89
74C42	16	1.19	74C165	16	1.29	74C911	28	8.95
74C48	16	1.79	74C173	16	.89	74C912	28	8.95
74C73	14	.69	74C174	16	1.19	74C915	18	1.19
74C74	14	.59	74C175	16	1.19	74C917	28	8.95
74C85	16	1.39	74C192	16	1.39	74C922	18	4.49
74C86	14	.29	74C193	16	1.39	74C923	20	4.95
74C89	16	5.95	74C195	16	1.29	74C925	16	5.95
74C90	14	1.09	74C221	16	1.75	74C926	18	5.95
74C93	14	1.09				80C95	16	.69
74C95	14	1.19				80C97	16	.69

LINEAR

TL071CP	8	.79	LF355N	8	1.09	LM747N	14	.69
TL072CP	8	1.09	LF356N	8	1.09	LM748N	8	.59
TL074CN	14	1.95	LM358N	8	.59	µA760HC		9.95
TL081CP	6	.59	LM359N	14	1.79	LM1456V	8	1.95
TL082CP	8	1.19	LM370N	14	4.95	LM1458CN	8	.59
TL084CN	14	1.95	LM373N	14	4.95	LM1488N	14	.69
LM109K		5.95	LM377N	14	1.95	LM1489N	14	.69
LM301CN	8	.39	LM380CN	8	1.09	LM1496N	14	.99
LM302H		2.49	LM380N	14	.89	LM1605CK		9.95
LM304H		1.95	LM381N	14	1.79	LM1800N	16	2.49
LM305H		.99	LM382N	14	1.49	LM1871N	18	2.95
LM307CN	8	.49	LM384N	14	1.95	LM1872N	18	3.25
LM308CN	8	.69	LM386N-3	8	.89	LM1877N-9	14	2.95
LM309K		1.25	LM387N	8	1.39	LM1889N	18	1.95
LM310CN	8	1.95	LM389N	18	1.19	LM1896N	14	1.59
LM311CN	8	.59	LM391N-80	16	1.19	LM2002T		1.95
LM312H		2.79	LM392N	8	.59	ULN2003A	16	1.49
LM317T		1.19	LM393N	8	.45	XR2206	16	3.95
LM317K		3.49	LF398N	8	3.95	XR2207	14	2.49
LM318CN	8	1.59	LM399H		5.95	XR2208	16	1.79
LM319N	14	1.49	LF412CN	8	1.95	XR2211	14	2.95
LM320K-5		1.35	TL494CN	16	2.79	LM2877P		1.95
LM320K-12		1.35	TL496CP	8	1.59	LM2878P		2.95
LM320K-15		1.35	NE531V	8	1.79	LM2901N	14	.79
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out the touchscreen interface), a communications program called DR Talk that's a modestly revised version of the popular PC-Talk III freeware program, a sophisticated menu generator, and a flexible text editor that replaces DR's venerable ED line editor (the new editor, DR Edix, is licensed from Emerging Technologies of Colorado, which also sells it as just plain Edix). The assembler and debugger are no longer included but can be purchased as part of a "programmer's toolkit" for between $50 and $100. Neither GSX nor DRNet are part of the Concurrent PC-DOS package, and the program can only handle a maximum of two users.

But Concurrent PC-DOS has some nice features. It will recognize, read, and write both CP/M and MS-DOS disks and can run CP/M programs stored on MS-DOS disks and vice versa. Its front-end file-handling utility and extensive help screens simplify novice use. Full MS-DOS 2.xx file and directory structures are supported, and Concurrent PC-DOS makes, changes, and removes named directories with ease, while still allowing you to employ the CP/M "user area" convention.

However, windowing remains something of a chore. You can create a multitude of windows for application programs all over the screen, but because window creation does not employ a mouse (like Visi On, Microsoft Windows, and DesQ), you have to be adept at entering lengthy and rather cryptic command lines. And if your software was designed to avoid the operating system and write directly to the screen, the display can be corrupted and final results are unpredictable. Though multitasking is indeed possible, you have to keep close watch over memory allocation and usage to avoid disaster. Finally, not all 8088/8086 software will run under Concurrent PC-DOS, and that which will may not be able to run in more than one window at a time. (The operating system comes with a list of acceptable software that includes most top-selling programs, such as WordStar, MultiMate, dBASE II, Lotus 1-2-3, the PFS series, etc.)

Looking at the prospects for the program, there is as yet no indisputable proof of a crying demand for concurrency on the 8088-based IBM PC and IBM is responding to that challenge with TopView, a product of its own. The ability to mix CP/M-86 and MS-DOS software is a marginal benefit when you consider how little CP/M-86 software has been sold to date. Also, in an era when "ease of use" is a watchword, an operating system that requires as much care to operate as this one does seems something of an anachronism. Lastly, as most 16-bit computers are sold with an MS-DOS operating system to begin with, one wonders how many consumers will be willing to shell out an additional $295 for a second operating system that's a mixed blessing. ■

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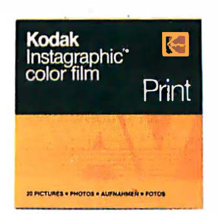
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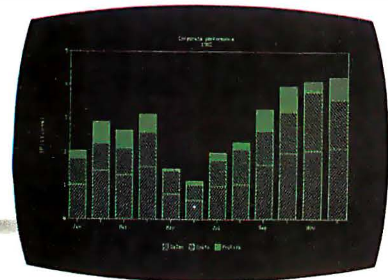
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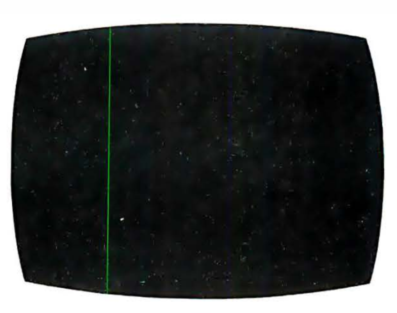
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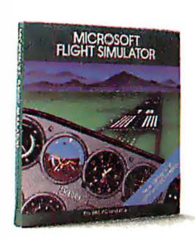


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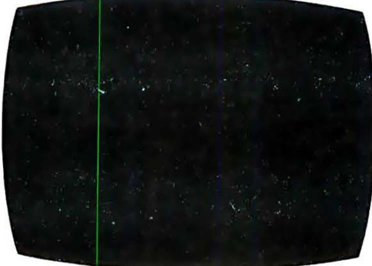




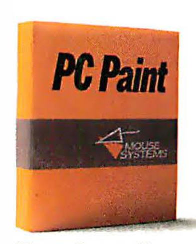


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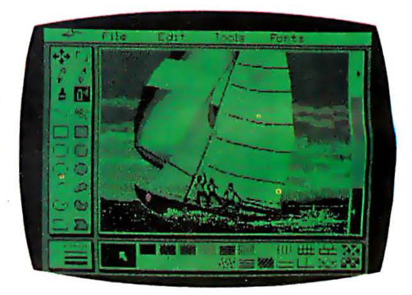


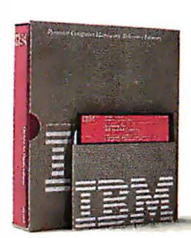


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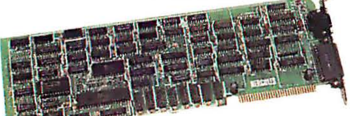






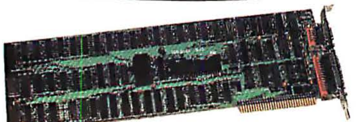
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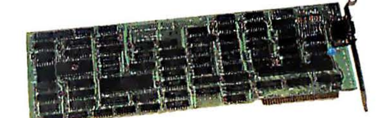
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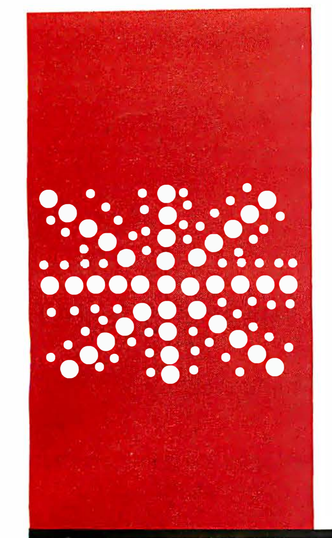
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Prolog on Microcomputers

Logical propositions replace computer-oriented instructions

BY DICK POUNTAIN

In a recent column (September, page 415) I alluded to the relatively great importance of the Prolog language in European artificial-intelligence (AI) laboratories. Interest in Prolog is hotting up in the U.S.A. (where LISP has been the traditional AI tool for many years). As the language is now available on humble home computers in the U.K., I'll devote this month's column to a brief look at micro-Prolog, a dialect written originally for the Z80, which was the first microcomputer implementation of Prolog.

The name Prolog is a contraction for "programming in logic," and the intention of its inventors was to create a computer language in which logical propositions about known facts could replace computer-oriented instructions about data structures. In other words, Prolog was to be (and to a large degree is) the highest-level computer language yet devised. Prolog was first implemented at the University of Marseilles in 1972 by Colmerauer and Rousell, and since then many mainframe dialects have been produced at various universities, including Edinburgh, London's Imperial College, and Budapest. Much publicity has been given to the adoption of Prolog by Japanese workers as the "core" language for their Fifth Generation project.

The philosophy of logic programming is fundamentally different from that of other computer languages. In the terminology of Prolog users, most languages are imperative: to solve a problem you must find a way to tell the computer what to do (in converting an algorithm into a program you are seeing things from the computer's point of view, giving it objects that it understands). Prolog sets out to be declarative: to solve a problem you tell the computer the facts you know already and, in the ideal case, the way the machine works it out is of no concern to you.

Here's an example that illustrates the difference. Multiply three by five in your head. Now ask yourself how you did it. Unless you are very unusual, you will not have used any sort of multiplication algorithm for so simple a calculation. In fact, you have a built-in database of such results, which you learned at school. If instead I ask you to multiply 56134 by 678103, then you will have to resort to an imperative method (long multiplication), which explicitly sets out the steps required to achieve an answer, though at the bottom level of this calculation you will still call upon your declarative knowledge to do the single-digit partial multiplications.

Computers are still at a stage where the simplest of activities have to be spelled out in an imperative way, painstakingly describing, in machine terms, the steps that a human being takes for granted. The ideal of logic programmers is to reach a stage where by formally specifying your problem (using a logical predicate calculus), you will have written the program to solve it; the specification is the program.

Prolog is not yet by any means a pure-logic language. It's much more declarative than other languages, but it still runs on a real computer, which you can't ignore completely. Prolog programmers have to read their programs in two distinct ways: a declarative (problem-oriented) reading and an imperative reading that considers matters such as control flow (which should ideally be of concern only to the computer).

MICRO-PROLOG

Written by Frank G. McCabe and Keith L. Clark, micro-PROLOG is a simple dialect of Prolog. It was written at Imperial College in the Logic Programming Unit, which is headed by Prolog guru Professor Robert Kowalski. The first version appeared over two years ago, written in Z80 assembler for CP/M 2.2 systems. Since then versions have been produced for the Sinclair Spectrum (Z80), the Acorn BBC Micro (6502), and for 8088-based systems including the IBM PC under MS-DOS or CP/M-86. Logic Program-

(continued)

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Micro-PROLOG has floating-point arithmetic—quite an achievement given that there are many C compilers and LISPs that don't.

ming Associates, a company set up by the author and colleagues, sells the CP/M and MS-DOS versions.

Prolog can be, like LISP, rather greedy for both memory and processor time; to make it work usefully on a microcomputer, micro-PROLOG has a much simplified syntax compared to "standard" systems (in the U.K., Edinburgh DEC-10 Prolog is considered the standard). It is, however, extensible, either by adding a range of utility modules provided or by the user's own code, written in micro-PROLOG, assembly language, or compiled languages like FORTRAN.

One of the supplied modules includes a front-end program called Simple, which provides a friendlier syntax than the LISP-like list form used internally. (Programs entered under Simple are translated into internal form.) Experienced users can dispense with this, and various other aids, to free more space. In the interests of clarity I shall use Simple syntax for all the examples here. The version referred to is 3.0 for CP/M 2.2 throughout.

Programming in micro-PROLOG

The micro-PROLOG language is, like BASIC and LISP, an interpreted language. A program consists of a database of facts and rules that you query to solve problems. Typical facts look like this:

```
John likes Maple-Walnut
Mary likes Butter-Pecan
John male
Mary female
```

Simple also allows such relationships to be expressed in a prefix form:

```
likes (John Maple-Walnut)
female (Mary)
```

This has advantages for relations that involve more than two things:

```
gives (John Mary ice cream)
```

though the infix form gives a more English-like appearance (which may or may not be a good thing). You can enter the preceding facts in either form or a mixture of both.

You can add facts about relationships of this sort to the database, list them (by *relation* name, e.g., "list likes"), delete them, or edit them using a special structure editor written in micro-PROLOG.

Once a database exists, you can make queries such as

```
is (John male)
YES
```

or

```
which (x : x likes Maple-Walnut)
John
No (more) answers
```

This latter query demonstrates the heart of Prolog programming: the search for pattern matches that result in variables becoming bound to the matched values. Logic programmers say that they become "instantiated." It's not dissimilar from the process of using wild-card matches in an operating system like CP/M or PC-DOS, except that instead of * or ? you use named variables that come back containing the values that match. This search facility is already built into Prolog and thus requires no programming effort from you at all; this is the mainspring of its power.

The Simple front-end program has the useful effect of automatically printing the value of the instantiated variables at the terminal (along with the message "No (more) answers") when a query is evaluated. The internal form of micro-PROLOG is more austere and free of side effects; it only prints the values if you explicitly add an instruction to do so, using the PP (print) relation. Otherwise, a query will

reply with nothing at all if it succeeds and a ? if it fails, which can be confusing for the beginner. I used the word "succeed" because Prolog programs can be regarded as either failing or succeeding, depending upon whether they can find a match in the database—for this reason queries often are referred to as "goals." In common with functional languages like LISP, the variables in a Prolog program only have a value during evaluation and cease to exist when it finishes.

If more than one person is known to like maple walnut ice cream, the which query will search for all of them and return something like

John
Fred
Wilma
No (more) answers

You could impose a further condition to narrow the search, so that

which (x : x likes Maple-Walnut
  and x female)

would only find Wilma.

You can use logical operators to combine existing relations and build rules, which themselves go into the database as new relations:

x fails-to-impress y if
  y likes Maple-Walnut
  and gives (x y Butter-Pecan)

A rule differs from a fact in that you don't have to enter any instances; Prolog deduces them itself from its existing knowledge. You'd use it in the form which (x : x fails-to-impress Wilma). This deductive ability is, of course, what makes Prolog suitable for writing expert systems. You can probably see a certain symmetry in this query. It would be just as easy to ask which (y : John fails-to-impress y). Such symmetry is characteristic of Prolog programs, which are often reversible; take for instance the arithmetic relation SUM:

which (x : SUM(4.5 6.3 x))
10.8
No (more) answers

(micro-PROLOG has floating-point arithmetic, which is quite an achievement given that many microcomputer C compilers and LISPs don't). You also can use SUM "backward" to do subtraction:

which (z : SUM(35 z 97))
62
No (more) answers

Once we get into rules and queries involving several variables and logical relations, it helps to know how Prolog performs its searches. Facts are stored in the database in the order in which they were entered, and Prolog searches from the top. When two (or more) conditions are to be met, say, "John loves x and x likes spinach," Prolog tries to fulfill the first one (say, with Mary), then tries to comply with the second. If it can't do this, because Mary doesn't like spinach, "backtracking" occurs; in other words, Prolog abandons Mary and tries to find another solution to the first query, then starts again on the second. If Mary *did* like spinach, backtracking still would occur in case John has any polygamous leanings. All of this is again automatic and built into Prolog, and it is usually totally transparent to the programmer.

The departures from pure "declarative" style in Prolog often arise when you must intervene in the backtracking process because a solution is dependent on the ordering of the database. You do this with a construct called the "cut" (signified by /), which inhibits backtracking; just like GOTO among Pascal programmers, the cut is regarded as a distasteful necessity.

Prolog shares many features with LISP; in particular it works with lists and relies heavily on recursion. As an example of a recursive rule, take the definition of an ancestor given that the relation "parent-of" already exists:

x ancestor-of y if x parent-of y
x ancestor-of y if z parent-of y
  and x ancestor-of z

Notice that here we have a pair of rules. When reading such a pair it helps to imagine an implied "or" between them; x is an ancestor if they're

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a parent or if they're an ancestor of a parent.

The language micro-PROLOG uses a simple but elegant notation for lists—the expression (x|y) represents a list whose head is x and tail is y. If we match this expression to the list (fish chips peas) then x would be instantiated to (fish) and y to (chips peas). Though this notation can cause your brain to hurt at first, it is in fact very powerful and general. It's easy to write LISP-style functions if you want them; the definitions of car, cdr, and cons look like this:

```
car((x|y) x)
cdr((x|y) y)
cons(x y (x|y))
```

and you could use them so:

```
which(x : car((flip flop fly) x))
flip
No (more) answers
```

It may appear to you, from the scanty evidence presented so far, that Prolog is just a glorified database-query language. This is not so; it's a very general-purpose language, and, perhaps surprisingly, you can use it for system programs. Sizable parts of micro-PROLOG are written in micro-PROLOG, including the editor and the Simple front end.

As an example of a non-database program, why not the good old factorial, as I don't seem to have got it in yet this month:

```
factorial (1 1)
factorial (x y) if 1 LESS x
   and SUM (z 1 x)
   and factorial (z y1)
   and TIMES (x y1 y)
```

The first clause is merely the assertion that the factorial of 1 is 1. The second clause can only succeed if x is greater than 1 (the LESS relation) and proceeds by subtracting 1 and finding the factorial of the result in traditional fashion. The y1 is just another variable name; micro-PROLOG, for implementation reasons, only allows the letters x, y, or z optionally followed by a number as variable names, like some of the older BASICs. The program is used as in which(y : factorial(10 y)). In this case, you can't use the relation backward to find a number whose factorial is supplied, because LESS is only a test—it can't generate all the numbers that are greater than 1.

One of the more advanced features of micro-PROLOG is its "query the user" facility. If a program fails to find a match in the database, you can make it ask the user to supply the necessary information, add it to the database, and then succeed. This offers a neat way to create expert systems.

A somewhat similar facility is provided in the error-handling routine. When an error occurs (under Simple) you are given a number of options: the query can be made to fail or succeed; you can issue a command (e.g., to load a file) or edit the program; you can supply missing information to the database and then in all cases resume evaluation where it left off. The error response also can be customized by writing micro-PROLOG programs to take whatever action you wish.

Development Aids

The error trap just described creates a very powerful debugging environment, but there is more. You can load a trace package that goes well beyond those found in most other languages. As a query is evaluated step by step, the source code is displayed with the variables "filled in" with their current values. Again, there are options to succeed or fail particular conditions or to skip the trace for bits you're not interested in and merely show the result.

A structure editor is supplied to edit items in the database, but like some LISP editors it will not be to everyone's taste (mine included). It works

(continued)



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on the stored form of programs in internal-list syntax, rather than the Simple infix syntax, which is an immediate source of confusion. You edit by moving up and down in the levels of the list structure, rather than by moving the cursor through the text. Fortunately, you can always use an external editor such as WordStar, and for large jobs I suspect most people will.

You also can write and save modules similar to those used for the system options. You load a module en bloc and it only reveals those definitions that are on its export list; similarly, it only can use external definitions on its import list. All names not on the lists are private to the module and may be safely used outside it. You can kill a loaded module with a single command.

Random and sequential files of formatted records are supported and there is access to a variety of CP/M functions.

Virtual memory support is provided by allowing a program to refer to relations held on disk rather than in main memory. The clauses defining the relation in the database are merely replaced by a single clause referring to a disk file via the RPRED relation. Combined with the ability to have four files open simultaneously, this permits you to easily program quite sophisticated database-management applications.

For more experienced programmers there is a second front-end program called Micro that has the advantage of taking up less memory than Simple. It accepts programs in internal-list syntax but provides some of the nice features of Simple such as the error trapping. For the record, this is what internal syntax looks like:

```
((ancestor-of x y)(parent x y))
```

Users of the 8088 version also get a third front end called Dec that allows them to enter programs in the Edinburgh syntax.

While on this subject, there is a serious reason for writing in internal (rather than Simple) syntax, apart

(continued)



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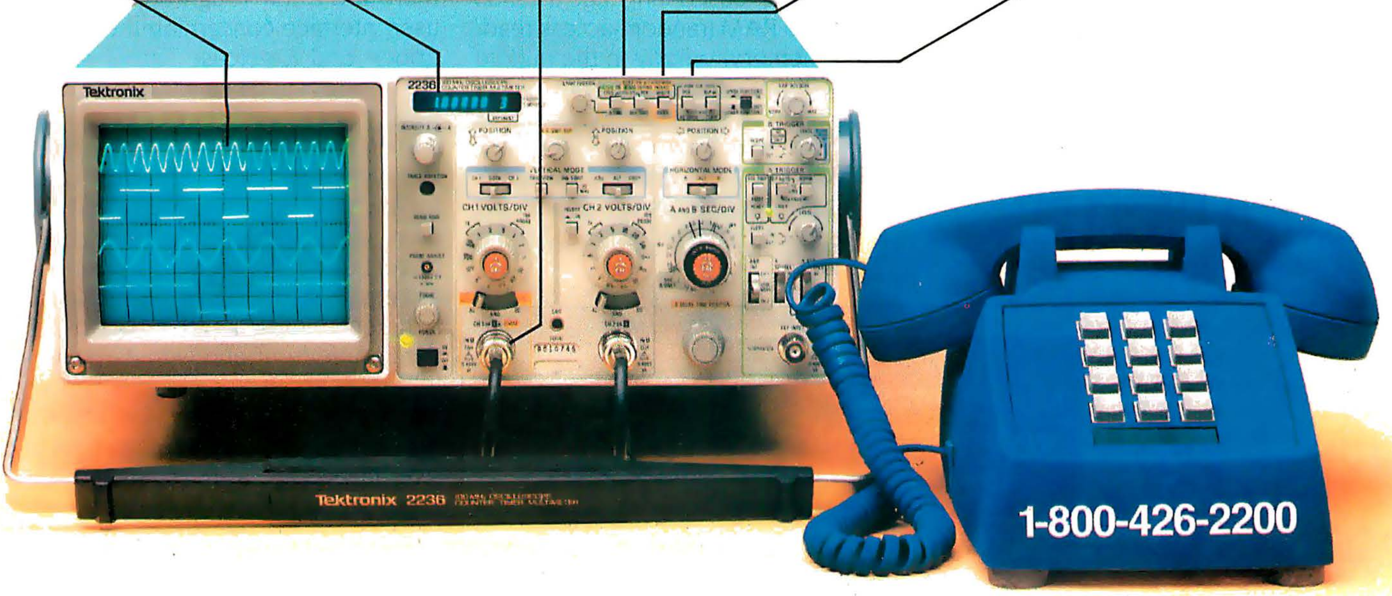
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from merely saving memory. An extremely powerful programming technique using "metavariables" is only possible in the internal syntax. There is not sufficient space to go into it in detail here but, in brief, a metavariable is a variable used to represent a whole chunk of program that can be given values at run-time. You can use this to achieve lots of "second-order" actions, equivalent in conventional languages to procedures with variable numbers of parameters, passing procedures as parameters, treating multiple parameters as a list, and much more. An advanced programmer can use this facility to write mind-bending system programs in a space that makes C look quite verbose.

Overall Performance

Getting a serious implementation of Prolog onto a personal computer is an impressive achievement in itself. The Z80 version that I've used occupies around 15K bytes in its naked form and Simple takes up another 8K bytes, which leaves enough room for quite sophisticated programs.

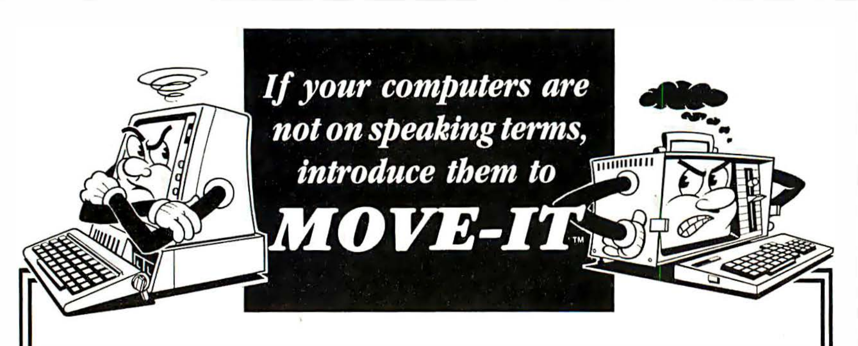
It also runs surprisingly fast, faster than any LISP I've tried and comparable to most interpreted BASICs. A colleague benchmarked it against DEC-10 Prolog (about $1,000,000 worth of hardware), which only turned out to be twice as fast as micro-PROLOG running on a 4-MHz Z80. Like any list-based language it tends to use up RAM (random-access read/write memory) quickly in the middle of a complex evaluation, but this is kept in check by automatic "success popping" to discard redundant stack items, and by not growing the stack at all for "tail recursive" definitions (ones in which the recursive call is the last item).

The main gripes I have with micro-PROLOG are the idiosyncratic editor (you might like it, though), the crude variable-naming system, and the overall complexity introduced by three different user interfaces, two syntaxes, and a host of optional module files. The variable naming is even worse than I have described so far, in that the names you give to variables when typing in a program are not preserved; when you later list the rule, more often than not micro-PROLOG will have changed all the names. Also there are a few rough edges to the user interface concerning the use of upper- and lowercase letters, which are distinguished in a very unforgiving way.

Even though it has some problems, the system remains a very good buy for anyone who would like to find out more about Prolog at a reasonable price. I don't find logic programming as easy as its most enthusiastic adherents would suggest, but using the Simple front end with its powerful aids is about as easy an introduction as you can get. The documentation is well written and comprehensive (including a thick paperback *Primer* and a *Reference Manual*) and the software is robust. A considerable bonus is the fact that you get the source code for Simple, Micro, and the other modules to modify or merely to study as examples of nontrivial Prolog programs.

Logic Programming Associates also has a related product called sigma-PROLOG that runs on large UNIX systems. Future plans are based around a compiler for micro-PROLOG that will produce pseudocode that is more compact and runs over five times faster than the interpreted version, and which accepts arbitrary-length variable names; this will not be ready until late 1985.

The DOS and CP/M versions of micro-PROLOG already are being distributed in the United States. Each version lists for $295. Further information can be obtained by contacting Programming Logic Systems, 31 Crescent Dr., Milford, CT 06460, (203) 877-7988. ■



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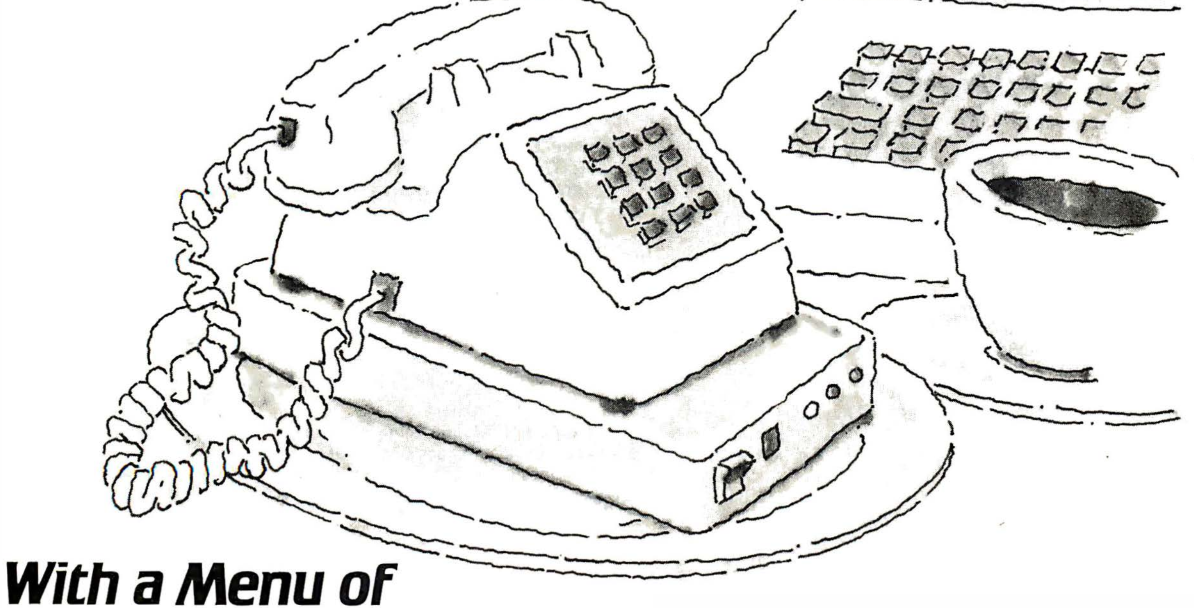
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In the October BYTE Japan column, I wrote about the inexpensive, RS-232C-equipped Brother EP-44 portable electronic typewriter/printer/terminal. I decided to buy it instead of a hand-held computer, and I'm still delighted with it; when I'm not traveling, it's my backup printer. It now looks like there's another good reason for having postponed buying a portable: some interesting new machines are available, and more will be coming along.

HAND-HELD COMPUTERS FROM EPSON

Hand-held computers are proliferating these days, with hot competition among Hewlett-Packard, Epson, Apple, Tandy, Sharp, NEC, and others. On the Japanese scene, Epson has released the new HC-88 and its companion, the HC-80. The HC-88 incorporates extensive Japanese-language processing features: large Japanese-character dictionaries are implemented in ROM (read-only memory), and it has a new, efficient method for entering Japanese characters from the keyboard. In addition to the *katakana* and *hiragana* phonetic alphabets, you can enter any of the 725 most frequently used characters using only two keystrokes, while the remaining 1800 require only three keystrokes. Lots of different systems exist for converting keyboard entries to Japanese-character displays, but this is just about the simplest and fastest one yet, and it is supported at the operating system level.

The HC-88 uses the CP/M operating system, stored in ROM. Standard applications software, also ROM-based, includes a Japanese-language word processor called "Portable Symphony Word," plus "Portable Supercalc" and BASIC.

The HC-88 (and the HC-80) is a triple-processor machine; the main processor is a Z80-equivalent CMOS (complementary metal-oxide semiconductor) microprocessor running at 2.45 MHz. For external storage, it has a built-in microcassette drive, similar to those in other Epson portables like the HC-40 and HC-20. Main memory consists of 64K bytes of CMOS RAM (random-access read/write memory), and an additional 64K bytes of RAM are configured as a RAM disk, backed up by a nickel-cadmium (nicad) battery. The liquid-crystal display (LCD) operates in three modes: a 480- by 64-dot graphics mode, an 8-line by 80-character alphanumeric mode, and a 3-line by 30-character Japanese-character mode. The built-in RS-232C interface operates at speeds ranging from 75 to 19,200 bits per second (bps), and a separate high-speed serial interface works at up to 38,400 bps. You also can buy a portable 3½-inch, 360K-byte microfloppy-disk drive as an option; list price for the microfloppy (which works through the high-speed serial interface) is about $425. The HC-88 itself lists for about $1225. That seems a bit steep in comparison to the HC-80, which offers just about all the features of the HC-88 except for the Japanese-language capabilities and carries a list price of only about $825. Epson says that WordStar and SuperCalc also are available (in ROM) as options for the HC-80, but I haven't had the opportunity to try out either of them.

APL TAKES WING

Not long ago I had a chance to get an advance look at an engineering prototype of a beautiful and unconventional new hand-held computer, the Big.APL. Since the appearance of the October What's New item, I've talked to Ampere about the specifics. I hope to have a chance to give one of the production prototypes a workout sometime soon; although the machine was expected to be in production by November, no one has actually confirmed a fixed date.

Ampere is a medium-sized company, based in Tokyo, that in the past has produced communications equipment, in-circuit emulators, and custom integrated cir-

(continued)

William M. Raike, who holds a Ph.D. in applied mathematics from Northwestern University, has taught operations research and computer science in Austin, Texas, and Monterey, California. He holds a patent on a voice scrambler and was formerly an officer of Cryptext Corporation in the United States. In 1980, he went to Japan looking for 64K-bit RAMs. He has been there ever since as a technical translator and a software developer.

cuits, in addition to software development activities. Its president, Takashi Kusanagi, talks about the APL language with missionary fervor and is understandably enthusiastic about the Big.APL.

Very few computers are visually distinctive; this one looks like a cross section of an airplane wing or, with the cover/display screen open, like a graceful futuristic chair (see the photos in the October BYTE, page 42). The case for the Big.APL was designed by Kumeo Tamura, whose design credits include the Datsun 280Z.

The rest of the Ampere computer is just as unconventional and as intriguing as its appearance. It's built around the powerful 32-/16-bit HD68000 microprocessor, running at 8 MHz. The heart of the machine is the software environment, which is an APL interpreter. The custom operating system, called Big.DOS, is APL-based, supports one foreground and one background task, and provides some windowing capabilities.

Although I haven't yet seen it, an integrated software package, written in APL and stored in ROM, will be supplied with the computer. Ampere says it will include a word processor, spreadsheet, and database handler, plus a communications package.

APL is a programming language that has proven extremely popular within the IBM mainframe community, particularly among scientific and academic users; it provides a concise way to state many numerical and statistical algorithms and is also suitable for text manipulation. The character set is very large and, at first, very confusing; instead of keywords like WRITE, FOR, etc., as in conventional languages, APL has unique characters for mathematical operations like finding the maximum, minimum, or sum of an array and for producing the transpose of a matrix, as well as for input/output operations. Usually interpreted instead of being compiled, it is subject to many of the same limitations (and advantages) as all interpreters. There are relatively few implementations of APL for personal computers; one is APL.68000, which I saw operating on the Sord M68, a 68000-based desktop computer. As far as I know, Ampere will be the first to use APL in a portable computer; its version of APL is an adaptation of APL.68000.

The Big.APL has lots of memory. Basic system RAM is 64K bytes, and 128K bytes of ROM is standard. Ampere reports that the RAM will be expandable to 512K bytes. In addition, it has three RAM/ROM cartridge slots; each cartridge can hold 64K

(continued)



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bytes of RAM or a megabyte of ROM. The internal 16-bit bus configuration is a standard Motorola VME (virtual machine environment) bus. Peripheral interfaces include a Centronics printer port and two RS-232C serial ports capable of speeds ranging from 75 to 19,200 bps. One of the serial ports is equipped with a built-in auto-dial 300-bps modem. No disk drive will be available initially, but the company says it's developing a portable 1-megabyte, 3½-inch microfloppy-disk drive as a companion to the Big.APL.

The display is an LCD panel built into the hinged cover, along with membrane-type function keys. The screen displays 25 lines by 80 characters in character mode and 200 by 480 dots in graphics mode, an upgrade from the planned 120- by 480-dot display and a respectable graphics performance for a hand-held.

The Big.APL contains a built-in microcassette drive, but the storage and transfer-rate specifications were not firm at the time of publication. In addition to the data storage, a separate voice track is provided on the cassette, and the computer includes a built-in microphone and speaker. The potential for educational applications is enormous—in fact, Ampere estimates that about 25 percent of the market will be in that area—and the possibilities for using voice instructions to provide a friendly but nonpatronizing user interface are also good. The availability of a voice track, combined with the built-in modem, also lets you use the computer as an intelligent telephone terminal and/or answering machine, capable of transmitting and receiving voice or data.

No price has been set, but a figure in the neighborhood of $2000, rather than $1500, seems more likely. I hope to be able to report on this machine again after I've had a chance to give it and its software a good workout.

MSX Machines

As I mentioned in last month's BYTE Japan, the IBM PC-compatibility issue has barely touched the Japanese personal computer market. But at the low end of the computer market here, as measured in terms of price, there's another standard: the MSX standard. The prices of MSX computers range from a little over $200 up to about $415 (not including a monitor), with most of them clustered near the bottom figure of the price range.

Introduced last year by Microsoft, MSX is a hardware and software standard for computers that are based on the 8-/8-bit Z80 microprocessor and that incorporate Microsoft BASIC in

(continued)



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32K bytes of ROM. All MSX machines have a standard cassette-tape interface and can accept standard ROM cartridges; all have 256- by 192-dot color graphics and 24-line by 40-character displays. Most models have built-in RF (radio frequency) modulators in addition to a composite video output, so that an ordinary television set can be used as a display, and provide an 8-bit parallel printer interface (Centronics-type). The amount of main memory varies from 16K bytes up to 64K bytes; most models incorporate an additional 16K bytes of video RAM for graphics, along with 8-octave sound generators, dual joystick interfaces, and other features. None of the machines I've seen yet has RS-232C serial interfaces, although several vendors have announced that RS-232C interface cartridges and/or expansion units will be available Any Day Now.

Well over a dozen MSX machines are on the market now; several new ones were introduced at this year's Microcomputer Show (see the September BYTE Japan). A separate magazine caters to owners of MSX machines, and a mammoth supply of games is available, both on tape cassettes and in ROM cartridges. Sadly, the marketing approaches to these machines are all targeted at the teenage and preteen market and the parents who buy such "toys." The idea that these computers might actually be useful for something besides game playing, generating sound effects, or learning to program in BASIC doesn't seem to be very widespread yet, judging from the fact that "software" has been nearly synonymous with "game" for MSX users up to now.

One development that could change the MSX image from frivolous to utilitarian is the coming availability of MSX-compatible 3½-inch microfloppy-disk drives. Although at this point Sony is the only manufacturer from which you can buy one (list price for a single 360K-byte drive is about $375), Microsoft has already developed an operating system called MSX-DOS that supports them. (Toshiba supposedly has a drive on the market, but I couldn't find a dealer that knew anything about it; Sanyo and Mitsubishi will release their drives Any Day Now.) As an operating system, MSX-DOS is file-compatible with MS-DOS in that it uses MS-DOS file formats, and Microsoft claims that it provides an environment that allows you to run "nearly all" CP/M-based programs directly.

With the wide range of available CP/M applications software, MSX machines could become appealing to a whole new class of users; in the MSX price class, the limited Japanese-language support and the 40-column screen format may not be severe limitations. (Although they don't provide Japanese-character support, the extended ASCII [American Standard Code for Information Interchange] character sets do include either the *hiragana* or *katakana* phonetic alphabets.) Also, limited Japanese-character support and (fairly primitive) Japanese-language word processing are available on ROM cartridges; however, they cost between $100 and $200 instead of being in the typical $12 to $20 game-cartridge range.

Some typical MSX models are described below, with approximate list prices and individual features.

1. Canon V-10 and V-20. 16K and 64K bytes of RAM, and priced at $225 and $270, respectively. Two slots for ROM, RAM, and/or interface cartridges. Available in two colors: black or white.
2. Toshiba HX-10S and HX-10D. 16K and 64K bytes of RAM, and priced at $230 and $275, respectively. One cartridge slot. No printer interface, but the HX-10DN has one and costs about $10 extra. Available in three colors: red, white, or black.
3. Victor (JVC) AV Personal Computer HC-6. 32K bytes of RAM, $270. For about $120 extra, a "superimpose adapter" is available that lets you superimpose computer-generated titles or games over ordinary television or video images.
4. Sanyo "Wavy" MPC-5, MPC-10, and MPC-11. Priced at about $225, $310, and $415, respectively. The MPC-5 has 16K bytes of RAM, while the other two have 32K bytes. The MPC-11 has a separate RGB (red-green-blue) video output and video-superimpose capability; both the MPC-10 and MPC-11 include a light pen. Japanese phonetic keyboard.
5. Pioneer PALCOM PX-7. About $370. Separate RBG video output and video-superimpose capability. Extended P-BASIC in addition to MSX BASIC. Two cartridge slots. A video-disk controller is built in, and Pioneer supplies various games on videodiscs. A video input and a video output are provided. Stereo input and output for audio.
6. Sony "Hit Bit" HD-55 and HD-75. About $225 and $290, respectively. The HD-55 has 16K bytes of RAM; the HD-75 has 64K bytes. Available in various color combinations. Japanese phonetic keyboard.
7. Hitachi H1. The model MB-H1 has 32K bytes of RAM, while the HB-H1E has 16K bytes and does not include an RF video output; they are priced at about $225 and $260, respectively. Both have two cartridge slots. Japanese phonetic keyboard. Requires a separate power supply.
8. Yamaha YIS503. About $270. Two slots, 32K bytes of RAM. An extensive range of music synthesizers and associated software is available. Japanese phonetic keyboard. The YIS303 with no printer interface, only 16K bytes of RAM, and a cheaper keyboard costs only about $205.
9. Fujitsu FM-X. About $205. 16K bytes of RAM and one cartridge slot. No printer interface.
10. Mitsubishi ML-F120. About $270. 32K bytes of RAM, two cartridge slots.
11. Matsushita CF-2000 and CF-3000, about $270 and $330 for 16K and 64K bytes of RAM, respectively. The CF-3000 has a separate keyboard and a superimpose option is available. Japanese phonetic keyboard.

Coming Up

The January BYTE Japan will cover the latest on integrated circuits, a new hand-held from NEC, and a high-tech printer from Casio, as well as my most recent computer purchase and the serious issue of software piracy. ■

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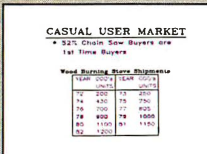
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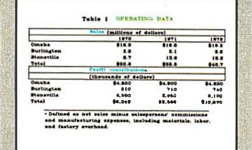
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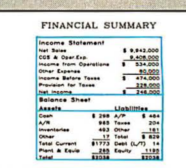
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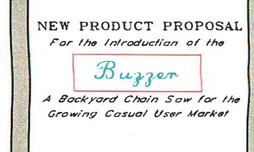

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Conducted by Steve Ciarcia

65816 Info, Please

Dear Steve,

Do you have information on the new 65816 chip that has been announced as an upgrade for 6502 systems?

If this chip is available, please print information as to company, price, and any comments you have regarding its use for upgrade of 6502 systems.

Bill Bunn
Covelo, CA

The Western Design Center of Mesa, Arizona, is in the production-test phase of the 65816, a 16-bit CMOS version of the 6502. (See the August and September issues for a two-part article on the 65816.) It will feature an 8-bit data bus and 24-bit addressing to address up to 16 megabytes of RAM. One version will be pin-compatible with the current 6502, so a direct replacement is possible. Existing 6502 software can be run with this new chip.

No further chip data is available at this time, but Hayden Software of Lowell, Massachusetts, is preparing an assembler and Pascal compiler for use with the 65816.—Steve

Digitized Stamps

Dear Steve,

I was very interested in reading your articles on the solid-state video camera (September and October 1983). I became interested in this field about a year ago because of my hobby, stamp collecting. I collect the first issues of Greece, which were printed in 1861-82. Because of the crude printing method, there are variations between each of the stamp positions on the printing plate. A study of these variations allows one to determine from which position any stamp was printed.

Visual inspection with a magnifying glass is tedious and often in error. Since I have an IBM PC, I thought that it would be possible to digitize an image of the stamp using a video camera and then have the computer recognize variations in each stamp by a pattern-recognition program. I purchased a Tecmar Video Van Gogh digitizer board ($300) and an RCA TC2000 closed-circuit video camera ($300 without lens). Using a Nikon close-up lens I already had, I was able to digitize the images of about 1500 stamps whose position I had previously determined by visual means. Standard variations for each of 150 positions were stored in memory and used as a comparison (by least squares) with stamps whose positions were unknown. This procedure was successful.

In addition to its use in my hobby, I also tried digitizing photographs and printing the image on an Epson MX-100 printer. The Tecmar board digitizes a 255- by 255-pixel image with 255 levels of gray scale for each pixel. Since the Epson MX-100 prints 810 dots horizontally in single-density bit mode, I wrote a program to digitize an image with 200 pixels across. To print the gray scale, a 4- by 4-dot matrix was used for each pixel (4 x 200=800). This matrix allowed the printing of 17 gray levels (0 to 16 dots). In my program, I divided the 255 gray levels from the digitizer into nine increments and used 2 dots per increment and 0 dots for white.

Lou Basel
Stamford, CT

I am impressed with your application of computerized video imaging to stamp collecting. It is a clever application of a proven concept.

The uses for the hardware you described are endless. Your setup has a higher resolution and more gray scale levels than my Micro D-Cam, so sharper pictures with better contrast can be obtained. With proper software and imagination, anything is possible.—Steve

MPX-16 Keyboard Interface

Dear Steve,

I recently took delivery of an MPX-16 empty board. It is not up and running (still shopping for a good price on a quality terminal) but will be shortly.

My IBM technical manual reveals that interfacing the IBM serial-type keyboard (non-RS-232C) requires a reasonably simple hardware design supplement to the MPX-16, and software will be needed to drive it.

My problem is primarily time. To wire-wrap my own hardware interface would not be cost-effective.

Do you know where I can get an assembled interface?

Allan J. Domuret
Fair Oaks, CA

It is not necessary to wire-wrap a keyboard interface for your MPX-16. The MPX-17 is an IBM Keyboard Interface Card that plugs into an expansion slot to allow the use of your IBM or Key Tronic keyboard. It includes a tone generator and a 2-inch speaker and is available from The Micromint for $100.—Steve

No More Ringing!

Dear Steve,

I can find books on logic design and general interfacing techniques by the pound. But books dealing with the more basic issues of grounding, shielding, and decoupling (I think the generic term is "circuit analysis") have been difficult to find. One specific problem I am concerned with is ringing on lines, as I plan to move up to a 10-MHz system. From what I have read, 10 MHz is where systems become noticeably more susceptible to line noise and other gremlins.

L. A. Grinzo
Endwell, NY

Important procedures to follow in design of circuits in the 8- to 10-MHz range, where the faster microcomputers operate, include installing bypass capacitors at the power-supply terminal of each IC, proper termination of all signal lines longer than a few inches, and providing a ground plane for the longer lines.

Information may be obtained from IC manufacturers' data books and application notes. For example, the Signetics TTL Logic Data Manual *(Signetics Corp., 811 East Arques Ave., Sunnyvale, CA 94086) recommends 100-ohm lines terminated by connecting the line to the center point*

(continued)

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of a pair of 200-ohm resistors connected from V_{cc} to ground for lines more than a foot long. Reflections on shorter lines are usually not a problem at CMOS or TTL frequencies.

The book Grounding and Shielding Techniques in Instrumentation *by Ralph Morrison (John Wiley & Sons, 1977) will also provide useful information.—Steve*

It'd Be Neat If There Were

Dear Steve,

I enjoyed your September and October 1983 project, "Build the Micro D-Cam Solid-State Video Camera." I would like to put together a system for capturing mechanical drawings, maps, and various forms of line art on a microcomputer system. I would like to be able to manipulate or improve these drawings by performing functions such as zoom, rotation, thresholding, halftoning, filtering, and edge detection. In addition, I would like to reproduce the processed drawings on a plotter at various sizes and scales. I realize this process will require some fairly complicated vectorization software, which leads me to my question: Does the software necessary to drive such a system exist?

David A. Satko
Reston, VA

I don't know of any software system available for microcomputers that can do all the things you want, but a system just announced by Datacopy Corp. is described as a "word image processing system" that runs on an IBM PC XT. This system, called the Model 800, consists of a digitizing camera and supporting software. It reportedly can enter text, photos, and drawings into a computer for processing. Contact Datacopy Corp., 1215 Terra Bella Ave., Mountain View, CA 94043, (415) 965-7900 for more information.—Steve

Power Questions

Dear Steve,

Your article about power-line pollution (December 1983) was very good, but I have some questions. Does a series installation of protective devices offer any additional protection? Why did you use metal-oxide varistors (MOVs) rather than silicon zener diodes, which appear to have a faster reaction time? Also, how can you determine that an MOV has failed? Are there any obvious signs? Panamax Corp. (150 Mitchell Blvd., San Rafael, CA 94903) claims that its surge suppressor reacts in 5 picoseconds. Can any suppressor react that quickly? Panamax also claims that its uninterruptible power system (UPS) has a line-to-battery transfer time of 5 milliseconds. Is that typical?

Walter I. Nissen Jr.
Takoma Park, MD

My article on power-line pollution generated a lot of reader response. I was surprised that so many people were concerned with transient suppression.

Placing protective devices in series can offer increased protection. For example, a line filter placed ahead of a transient suppressor can help reduce some transients due to the filter's time constant. The filter components usually are able to withstand large transients.

I used MOVs instead of silicon zener diodes since they were more readily available (at any Radio Shack) and offered adequate protection. MOV failures usually result in a short circuit. A fuse in series with one leg of the MOV is a good idea to prevent a short across the line, and this can be used to trigger a neon bulb or LED, indicating failure.

The response time of a varistor or silicon zener diode is influenced by its lead length and configuration. It is usually shorter than its inductive lead effect and can be less than a few nanoseconds. The Panamax claim of 5 picoseconds is not unreasonable.

The 5-millisecond battery transfer time of the UPS is not unusual. Many manufacturers advertise times in the 1.5- to 6-millisecond range. Some units use the battery to generate the AC voltage. The power-conversion circuitry serves only to charge the battery. In this case, there is no transfer time.—Steve

Hardy Users Want Modem

Dear Steve,

I am the editor of a new newsletter for a hardy group of Epson QX-10 users in the Washington area. We are almost 100 strong after four meetings and are growing. I noticed by a show of hands how few own modems and thus are missing much of the microcomputer world.

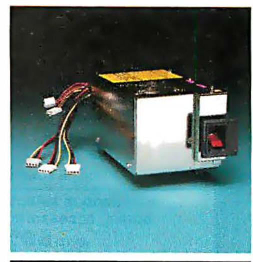
I own a Hayes 300 and often decline to download or send because of the length of time required. Modems introduce an intense social pressure into many homes:

(continued)

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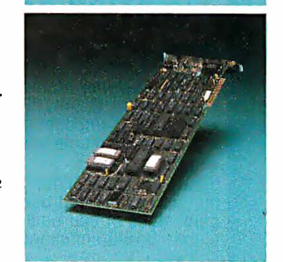
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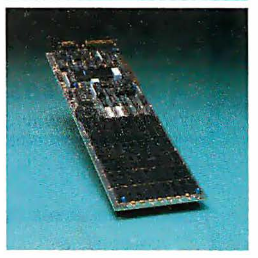
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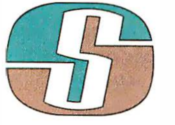
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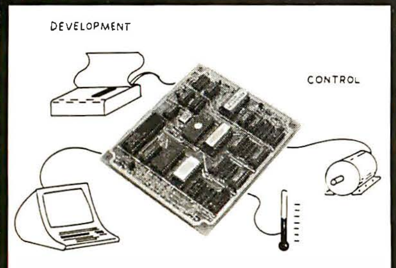
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Circle 416 on inquiry card.

who is going to use the phone and when, and who is waiting for a call that can't come through, and all the friends and acquaintances who exclaim about your busy phone.

I know, Circuit Cellar is off on very esoteric, exciting things, but why don't you help computer folks from coast to coast by selling us a kit for a 1200-bps modem? It should be a "smart" modem technically, stand-alone, and the parts, board, and case should cost $125.

JAMES N. DAVIS
Falls Church, VA

I have been thinking about a 1200-bps modem project but have been reluctant because of high cost. The most readily available 1200-bps chips are made by Exar, and a circuit built around them would cost about $150 just for parts. To offer it as a kit, with a printed-circuit board and instruction manual, would raise the cost to levels comparable with some of the commercially available units.

Obtaining FCC device approval would add substantially to the unit cost, so it could be offered only as a kit.

I have been waiting for some new devices to become available that will enable the construction of a 1200-bps modem for the price that you mentioned. I want to present such a project. So when I can offer a circuit for a reasonable price, it will be published.—Steve

HOME-CONTROL COMPUTER

Dear Steve,

I would like your help in constructing a Touch-Tone decoder for a remote control that would not only survey the situation of my home but would operate a Rainbow air cleaner robotically. This would essentially clean the house from anywhere.

ROBERT B. SINGER
Toronto, Ontario, Canada

I am planning a home-security/control project that will use a computer to control various devices directly or via the power lines, have a real-time clock to enable events to occur at precise times, include the capability of reminder messages, be callable via modem, and allow for remote control. It should meet your requirements.

On a recent consulting job, I demonstrated the prototype of this home-control computer to representatives from the National Association of Home

(continued)

Thinking of buying a modem? You owe it to yourself to check out the Qubie' 212A modems.

Inside Outside

Just a few years ago, computers needed big air-conditioned rooms to operate in, balefuls of money to buy, and a team of wizards to keep them running. The constant march of technological progress has given more and more powerful machines which cost less and less. Desktop computers more powerful than the early mainframe computers are the result of the evolution. The Qubie' modems represent the latest extension of this progress. Because up until now, a 212A compatible modem cost at least $500. Through the use of four low-cost, state of the art microprocessors, we can now offer two versions of our full featured 212A modem at prices the competition sells 300 baud modems for.

In The Beginning

In September of 1983 we introduced the first 212A modem card for the IBM PC available for under $300. The PC212A/1200 is a complete communications package including PC-TALK III software, modular phone cable, card edge guide, and instruction manual. The modem is an auto-dial, auto-answer type, which uses all the Hayes software commands so it can be used with any of the popular software packages including Crosstalk,™ and Smartcom.™ We picked the best software package we could find based on it's ease of use and features, PC-TALK III. Our modem includes features the old industry standard missed out on. Like being able to fit in one slot in a Portable PC or PC/XT. Or an optional connector to use the modem's serial port when not using the modem. Of course the topper is the $299 price, hundreds less than the competition.

Now Available Outside

Our standalone modem, the 212E/1200 can be used with any computer or terminal with a RS-232C serial port. You can use any Hayes compatible communications software on anything from an Apple to a Zenith. Many owners of IBM PC's are using it because they lack available expansion slots, or have more than one computer they want to use their modem with.

It's attractive gold anodized case houses seven status lights (who says low prices means a shortage of features). It fits comfortably under a standard telephone. It is also a 212A compatible auto-dial, auto-answer modem which supports all Hayes software commands. Even the switch settings are the same, so any software giving recommended switch settings for a Hayes modem can be used, without knowing what the switches do. There is a volume control knob for easy adjustment of the speaker's output. Included in the package is modular phone cable, a cable to hook it to your computer or terminal, and instruction manual. Choose the communications package right for your needs, and you're ready to go!

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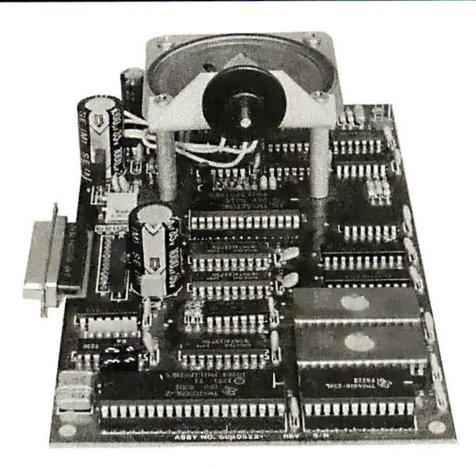
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Builders Research Foundation. They ordered three units on the spot, which they intend to demonstrate at the NAHB Show in January 1985.

This Circuit Cellar article should be in BYTE soon.—Steve

Where Do I Get Them?

Dear Steve,

I am currently pursuing the idea of building the Term-Mite ST Smart Terminal and the Sweet Talker II and interfacing them with my homebrew 6800 system, but where do I buy an NS455A Terminal Management Processor and an SSI263 Phoneme Speech Generator? I have tried all the electronics parts houses in my area, and no one can even provide me with addresses of manufacturers.

The second thing I need is information on some 6800 programs I have seen listed on the inside cover of *Ciarcia's Circuit Cellar, Volume I*. I wrote a letter to BYTE Books asking about these programs and have received nothing in return to date. Can you help me get a copy of these programs?

Douglas A. Kerslake
Norfolk, VA

The chip you want is the NS405A, which is presently available only from National Semiconductor. As production quantities increase, it probably will be stocked by distributors and mail-order houses. Contact National Semiconductor Corporation, 2900 Semiconductor Dr., Santa Clara, CA 95051, (408) 721-5000.

The SSI263 is a product of Silicon Systems Inc. and may be obtained from JDR Microdevices, 1224 South Bascom Ave., San Jose, CA 95128, (800) 538-5000.

The programs listed on the inside cover in volume I of Ciarcia's Circuit Cellar *were published in a bar-code format known as PAPERBYTE and may still be available from BYTE Books. I am not aware of any other listing.*—Steve ■

Over the years I have presented many different projects in BYTE. I know many of you have built them and are making use of them in many ways.

I am interested in hearing from any of you telling me what you've done with these projects or how you may have been influenced by the basic ideas. Write me at Circuit Cellar Feedback, POB 582, Glastonbury, CT 06033 and fill me in on your applications. All letters and photographs become the property of Steve Ciarcia and cannot be returned.

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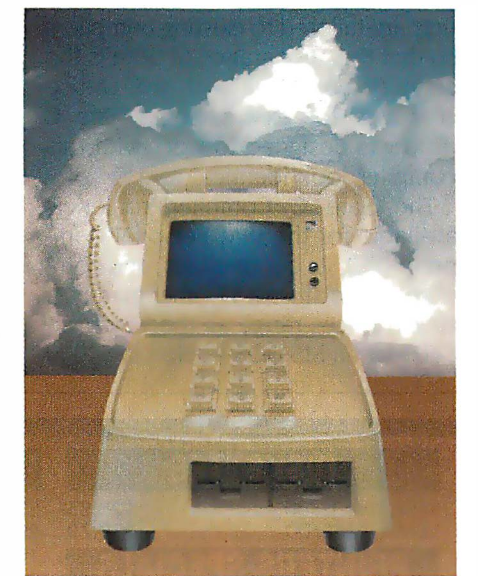
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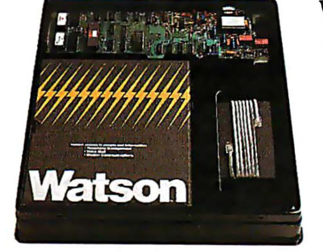
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(continued from page 120)
statement executes. The Profiler even generates a histogram showing the percentage of time the program executes a function or statement.

By revealing which parts of a program execute most often, the Safe C Profiler points the programmer to the code where optimization yields the greatest results. For example, in a function where multiple if . . . else tests are made, the test executed most often should appear first for optimal performance. The Profiler identifies this code for proper alignment by the programmer. This process is analogous to a delivery service analyzing all its truck deliveries to ensure that the truck doesn't backtrack when delivering goods.

The Safe C Profiler also profiles code that does not get executed. Often this exposes subtle errors, such as using a single = instead of the equivalence operator ==. This error, syntactically and lexically correct, could be hard to find unless you could show that a certain test was never being made—an indication that a bug existed. Profiling identifies code that hasn't been tested by repeated program execution, giving the testing phase of program development a new dimension.

Using these tools is similar to using a standard compiler. Catalytix's products are tailored to existing compilers so that the appearance of both is the same. If you work with the Lattice compiler, for example, the Safe C products designed to work with this compiler look identical to it.

The Safe C Compiler/Profiler is available for the IBM Personal Computer (PC), its compatibles, and computers from at least 17 other manufacturers. Prices range all the way from $400 for an MS-DOS version to $4000 for minicomputer versions.

Catalytix will shortly announce a C interpreter and an English-to-C/C-to-English translator, products BYTE will preview.

INSTANT-C

The value of interaction with programming languages is evident in the recent consumer release of an interpreted Pascal (see "Macintosh Pascal" in the June BYTE, page 136) and the success of Turbo Pascal, a fast compiler that provides the illusion of interpretation for small programs.

Several attempts at writing an interpreter for C have failed within the university community, but at least two commercial attempts appear headed for success. One is the Catalytix product mentioned earlier; the second is Rational Systems' Instant-C, which runs on Intel 8086-/8088-based com-

(continued)

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Early buyers of Instant-C help finance its development.

puters under MS-DOS or CP/M-86 and costs $500.

Instant-C supports all standard C features except initialization, parameterized #defines, declaration in compound fields, and an assembly-language interface.

Envisioned primarily as a language-development tool, Instant-C features a compiler, an interpreter, a full-screen editor, a linker/loader, a library of C functions, a source debugger, a UNIX-like lint utility (that checks for the number of arguments passed to a function and for external variable declarations), and a source-code formatter.

Although Instant-C has been advertised since midsummer, as of this writing (October) the product is still under development. A potential buyer receives an explanation of this situation; if he decides to buy, he gets the latest version (in my case version 0.88) with the promise of subsequent versions as they become available. This means that early buyers of the product help to finance its development. The people at Rational Systems deserve credit for being honest with their customers about this unusual marketing technique.

To use Instant-C, you load the interpreter and can subsequently enter and execute any valid C-language code. You can call library functions or user-written functions stored on disk. Typing a function's name, including arguments where they are necessary, calls the function. The interpreter cannot use compiled code but must have source files for interpretation.

The most obvious use of the interpreter for execution of individual commands or library functions is for instructing the novice C programmer.

Experienced programmers will use a different scheme. From the interpreter, typing ed *filename* places you in the editor to create a new function or edit an existing function. The full-screen editor offers reasonable functionality and an attractive display area. On the IBM PC, the editor uses the cursor, insert/delete, and page-move keys.

Within the editor, you write C source code in the normal manner. When you execute the editor's exit command, the source code is partially compiled and, if there are no errors, you return to the interpreter. Calling the name of the function just written executes the code, providing an im-

(continued)

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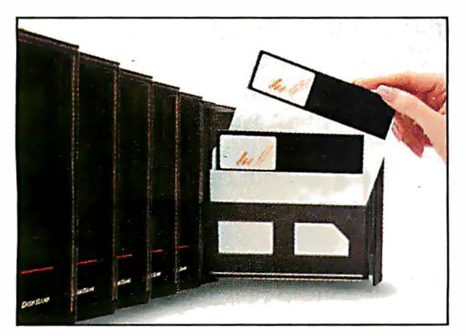
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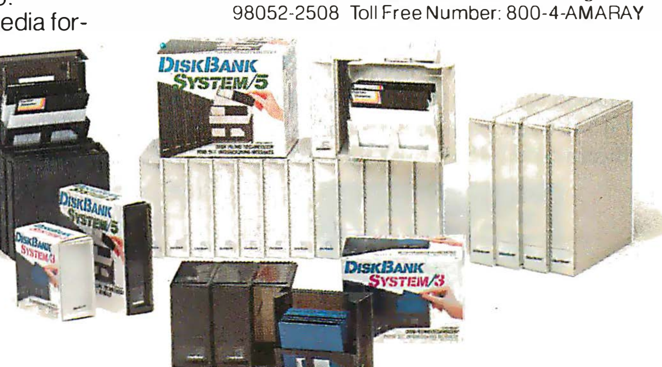


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mediate way to verify logical correctness.

Checking of syntax errors is handled by a compiler pass made when exiting the editor. If errors are discovered, an error message appears on the top line of the screen and the cursor drops back within the source code to the location of the error. Errors are uncovered one at a time until the source file is syntactically clean.

When I examined Instant-C, the debugging facilities were just being defined and implemented. The debugging commands include

back—show all the functions called to a breakpoint
go—resume after breakpoint
local—enter a function for local execution
trace—set breakpoint functions
untrace—turn off tracing
reset—turn off breakpoints

These facilities implement well-known debugging techniques.

Rational Systems said it expects to complete and ship version 1.0 of Instant-C by November 15. The program requires 256K bytes of memory, but 384K bytes is recommended for developing programs of any length.

C Source Debugger

Mark Williams Company, purveyor of the UNIX-like Coherent operating system, introduced its MWC-86 C compiler and an accompanying C Source Debugger on September 1. The products work together and sell as a package for $495. In this description, I'll look only at the debugger.

The C Source Debugger (called by the company, in typical UNIX fashion, dbc) can debug your C programs in C instead of in machine language. dbc does not add code to your programs and enables you to view the source code as you debug. dbc can provide

- a trace of the execution of any statement with or without breakpoints
- a display of the value of variables and expressions during program execution
- single-step execution of code
- separate windows for source, program output, history, and evaluation of expressions
- exploration of the stack

These features make use of a simple user interface that relies heavily on function keys and page-move keys.

Using dbc resembles using an assembly-language monitor. Instead of looking at representations of the computer's memory and central-processor registers, you look at C source code and a variety of windows that show program output and evaluation of variables and expressions. You can execute the code with or without breakpoints, backtrace through the code, single-step through the program, and track the changing of variables and expressions. You can also record a history of your debugging sessions, available in the separate history window.

The programmer records errors and changes that need to be made to the source code. You can make changes to the source within the debugger, permitting a way to test different strategies for solving a problem; however, the changes cannot be saved.

You can set breakpoints (*tracepoints* in the lexicon of dbc) to halt execution when a line of code executes or when the value of an expression changes. Programmers can toggle tracepoints on and off. You can execute programs with tracepoints through to the end with tracepoints overridden, but a trace history is listed in the history file.

The program window displays the output of your program as if it were executing without dbc. This window is saved and restored when the programmer switches between windows.

The underlying theory behind dbc is analogous to building a car's engine block out of clear plastic so that mechanics can watch the internal engine parts function. If something goes wrong, the mechanic can spot it and then later go inside the engine to make repairs.

The C Source Debugger, like the MWC-86 C Compiler, requires 256K bytes of memory. ■



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(continued from page 123)
a constant lower value in the cladding. The *single-mode* fiber (2c) has a step-index profile, but it is distinguished by its much smaller core size and by a smaller difference in index between the core and the cladding.

Light propagation in the step-index multimode fiber is depicted in figure 3. Only rays of light that enter the fiber passing through the longitudinal axis within a certain solid angle, the *angle of acceptance*, are able to travel within the core. Three modes are shown in the figure; in reality, hundreds of discrete modes typically propagate in a single fiber.

Figure 3 also illustrates the major limitation of step-index fibers. The low-order modes, those launched into the fiber at small angles with respect to the axis, travel a shorter ray distance to reach a given point along the fiber than do the high-order modes, those launched at large angles. This effect, called *intermodal distortion*, or "modal time dispersion," constricts the bandwidth of the cable; waves that start out at the same instant arrive out of sync at the other end. It smears out any signal waveforms that have been modulated on the light.

Another area of disturbance, intramodal time distortion, is manifested in two ways: as *material dispersion*, resulting from the slightly different indices of refraction that the fiber presents to different wavelengths of light (essentially the same problem that causes chromatic aberration in lenses) and *waveguide dispersion*, resulting from the inherently longer path taken by longer wavelengths, which reflect at more oblique angles with the cladding. Taking into account all these factors, optical fibers are assigned dispersion ratings expressed either in bandwidth—megahertz (MHz) per kilometer—or in time spread—nanoseconds per kilometer.

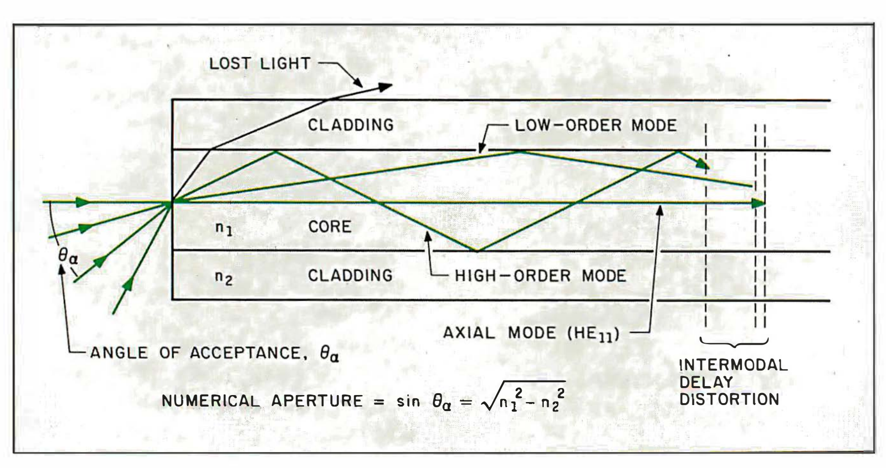


Figure 3: *The step-index multimode fiber enables propagation of any ray of light that enters within the angle of acceptance θ_a. The numerical aperture is a measure of the fiber's ability to accept light. The high-order modes travel over a longer path than the low-order modes and therefore arrive later at any given point down the cable, causing intermodal delay distortion.*

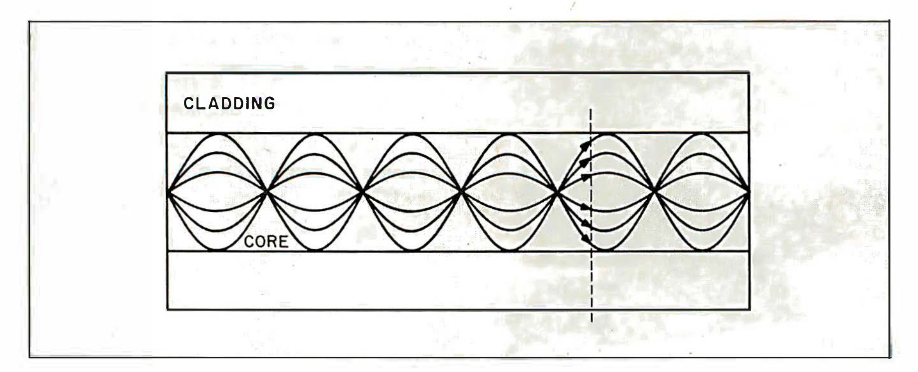


Figure 4: *In a graded-index multimode fiber, the rays are conveyed in curved paths. The more sharply curved paths of the high-order modes lie mostly in the low-refraction areas near the cladding, so they propagate faster and arrive at the same time as the low-order modes.*

Graded-index fibers were developed to overcome these limitations. The refraction index changes gradually across the core's diameter to guide the various modes along curved paths, as shown in figure 4. Because the index of refraction is essentially an expression of the speed at which light travels in a material, the gradations of index reduce the delay suffered by the high-order modes: although they zigzag nearer the cladding, they travel more swiftly while in that region and thus do not fall behind the low-order modes, which meander less but travel mainly in the slow lane in the middle of the core.

(These explanations are simplified and leave out consideration of the wave nature of light, which must be taken into account for a full understanding of the processes involved. For rigorous analysis, see reference 8. But ray optics can be applied to all phenomena that are described by the wave equation as long as they satisfy the additional requirement that the light wavelength be short compared to the dimensions of the waveguide.)

There is a way to avoid intermodal distortion altogether. Careful selection of refraction index and core radius can create a waveguide that cuts off all angularly incident modes and enables propagation only straight down the center axis of the fiber. With this major source of disturbance eliminated, single-mode fibers offer far greater usable signal bandwidth.

(continued)

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However, they are much more trouble to install, due to the tiny core, and they must be driven by laser transmitters, making their interface circuitry more complex and expensive than that needed by multimode fibers, which can be driven by light-emitting diodes.

Single-mode fibers are not, however, inherently immune to intramodal delay distortion, but one property of silica glass provides a convenient means of avoiding it. In the visible spectrum of light, material dispersion causes longer wavelengths to travel faster than shorter ones. But down in the near-infrared region around wavelengths of 1.1 to 1.3 microns, the opposite begins to happen: longer wavelengths begin to travel slower. At some wavelength the material and waveguide dispersion meet and cancel each other out; this is the *zero-dispersion point* (ZDP). The ZDP occurs naturally in pure silica glass at 1.27 microns. Since in principle single-mode fibers work with a single coherent wavelength, one way to exploit the ZDP is to find a laser that emits light at 1.27 microns.

However, the pursuit of greatest overall efficiency brings in other factors. Usually glass waveguides suffer from losses due to Rayleigh scattering, which occurs because of inevitable density and compositional variation within the glass. Rayleigh scattering lessens as wavelengths grow longer. To take advantage of this lessening, dopant materials can be added to the glass until its ZDP is shifted into the range between 1.3 and 1.6 microns. Happily, many formulations of glass reach their lowest possible absorption in this range. (Below this, molecular thermal scattering becomes a problem.) Some care in manufacture must be taken to avoid impurities in the glass that increase absorption, but this is no longer an excessive task. A typical light-absorption curve for a high-silica fiber is shown in figure 5.

There are two major ways of manufacturing optical fibers. The original technique developed for step-index fibers is the *double-crucible* method. One platinum crucible contains the molten

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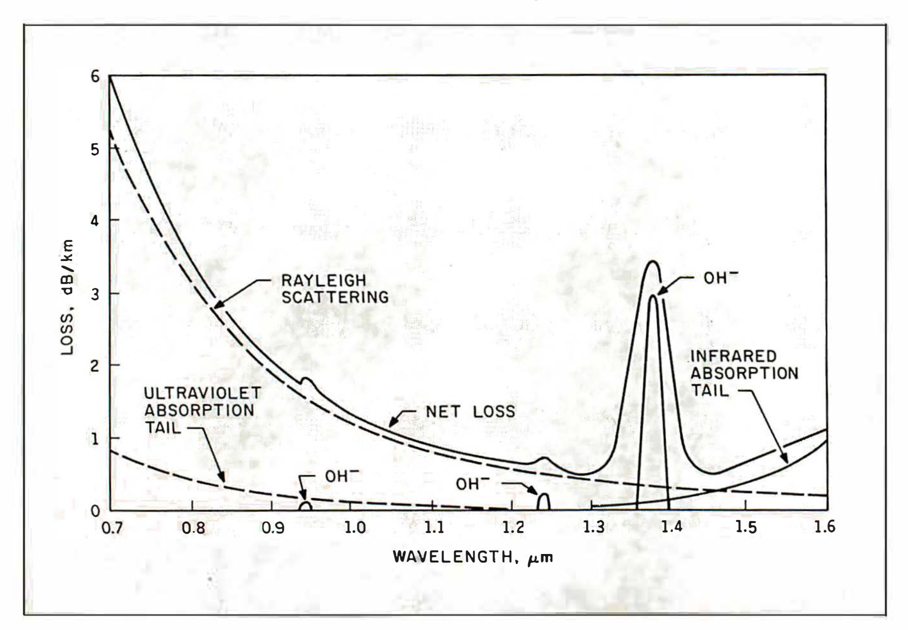


Figure 5: *Light absorption in a high-silica (relatively pure) glass fiber. In this region of the curve, the ultraviolet electron-excitation absorption tapers off and the infrared molecular-vibration absorption begins. Light at the wavelengths near the bottom of the curve can be carried for long distances.*

Table 1: *Comparison of the three kinds of optical fibers.*

	Step-Index	Graded-Index	Single-Mode
Light source	LED or laser	LED or laser	laser
Bandwidth	wide (but under 200 MHz/km)	very wide (200 MHz to 3 GHz/km)	extremely wide (over 3 GHz/km)
Splicing	difficult	difficult	very difficult
Typical application	computer data links	moderate-length telephone lines	telecommunication long lines
Cost	least expensive	more expensive	most expensive
Core diameter (microns)	50 to 125	50 to 125	2 to 8
Cladding diameter (microns)	125 to 440	125 to 140	15 to 60
Attenuation (dB/km)	10 to 50	7 to 15	0.2 to 2
Numerical aperture	0.22 to 0.48	0.16 to 0.21	less than 0.12


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A single-mode system costs approximately ten times as much as a multimode system.

glass for forming the fiber core; this crucible is nested inside another that contains the molten glass for the cladding. Both crucibles have drawing nozzles, arranged so that the clad fiber can be drawn from the intersection of the melts. Graded-index fibers are made by depositing materials from a vapor (vapor deposition) on or within a starting tube or cylinder of glass for creating a *preform rod*, in which the varying chemical content at different depths controls a varying index of refraction. The preform rod is then drawn long and thin to achieve the final fiber. Some progress has been made recently in fabricating graded-index fibers more cheaply by a modification of the double-crucible method that employs ion migration.

The characteristics of the three types of fiber-optic waveguide are summarized in table 1. Although single-mode cable has the greatest potential, the multimode types are easier to work with and have cheaper support circuitry. In view of this, multimode types will probably continue to dominate in applications that require less than ultimate bandwidth and efficiency. (Currently a single-mode system costs approximately ten times as much as a multimode system.) But in spite of the costs and the difficulties encountered in working with them, single-mode fiber-optic cables, with their undeniable advantages, are carving out an increasing slice of the long-distance, wideband communication pie.

The Photon/Electron Connection

The devices that transmit light into optical-fiber waveguides fall into two main classes: the exotic injection laser diodes (ILDs) and the familiar light-emitting diodes (LEDs). Possessing high speed, high power, and narrow emission bandwidth, the lasers serve well in applications where long continuous runs of cable carry wide-bandwidth signals. They are essential in single-mode applications. But in multimode installations LEDs can be used at lower cost, particularly where low-loss fibers are used in distances less than 1 kilometer and for data rates under 10 MHz—the kind of conditions existing, for example, in many computer local networks. Both ILDs and LEDs are available in various wavelengths suitable for fiber-optic work, with the 0.85 micron and the infrared 1.3 microns the most popular.

Because an LED usually radiates into a rather broad angle, the efficiency of its coupling to the end of the optical fiber greatly influences the efficiency of the whole link. Fibers with small numerical apertures especially need precision in alignment. But for the installer's convenience, many transmitter LEDs now come in a package with a fiber stub already installed in proper alignment.

Several kinds of optoelectronic devices can be used as the photodetector in a fiber-optic receiver, including standard *p-n* junction photodiodes, PIN (positive-doped, intrinsic, negative-doped) photodiodes, phototransistors, and avalanche photodiodes (APDs). PIN photodiodes are most often used in data-transmission links, even though they provide no direct gain. The undoped intrinsic layer gives the component low capacitance, enabling frequency response up to the gigahertz range, and the 5- to 10-volt bias required is easily provided. Avalanche photodiodes, which give inherent signal gain of 50 to 500, need a reverse-bias potential of hundreds of volts and are sensitive to changes in temperature, so the receiver circuitry must be complex. Standard phototransistors have high capacitance that restricts their response at high frequencies, a particularly undesirable trait in an application wherein the detector bandwidth often governs the bandwidth of the system.

An interesting side effect of the growth of fiber optics has been a resurgence of use in semiconductor fabrication of the long-neglected element germanium. Germanium photodiodes excel in sensitivity in the infrared spectrum, where silicon components are practically useless.

In the Future

Fiber optics is a new field. Many of its potential applications lie waiting somewhere down the learning curve. The technology is still being stretched to fit new uses. But even so, fiber-optic communication has found a place in today's world.

Fiber-optic cable will likely see increased utilization in computer networks. Its compactness and immunity to electromagnetic interference are attractive to designers of local computer-communication schemes, and the technology will achieve more use as current problems are solved and costs are brought down. In part 2 I'll look at some ways fiber optics may be used with computers. ■

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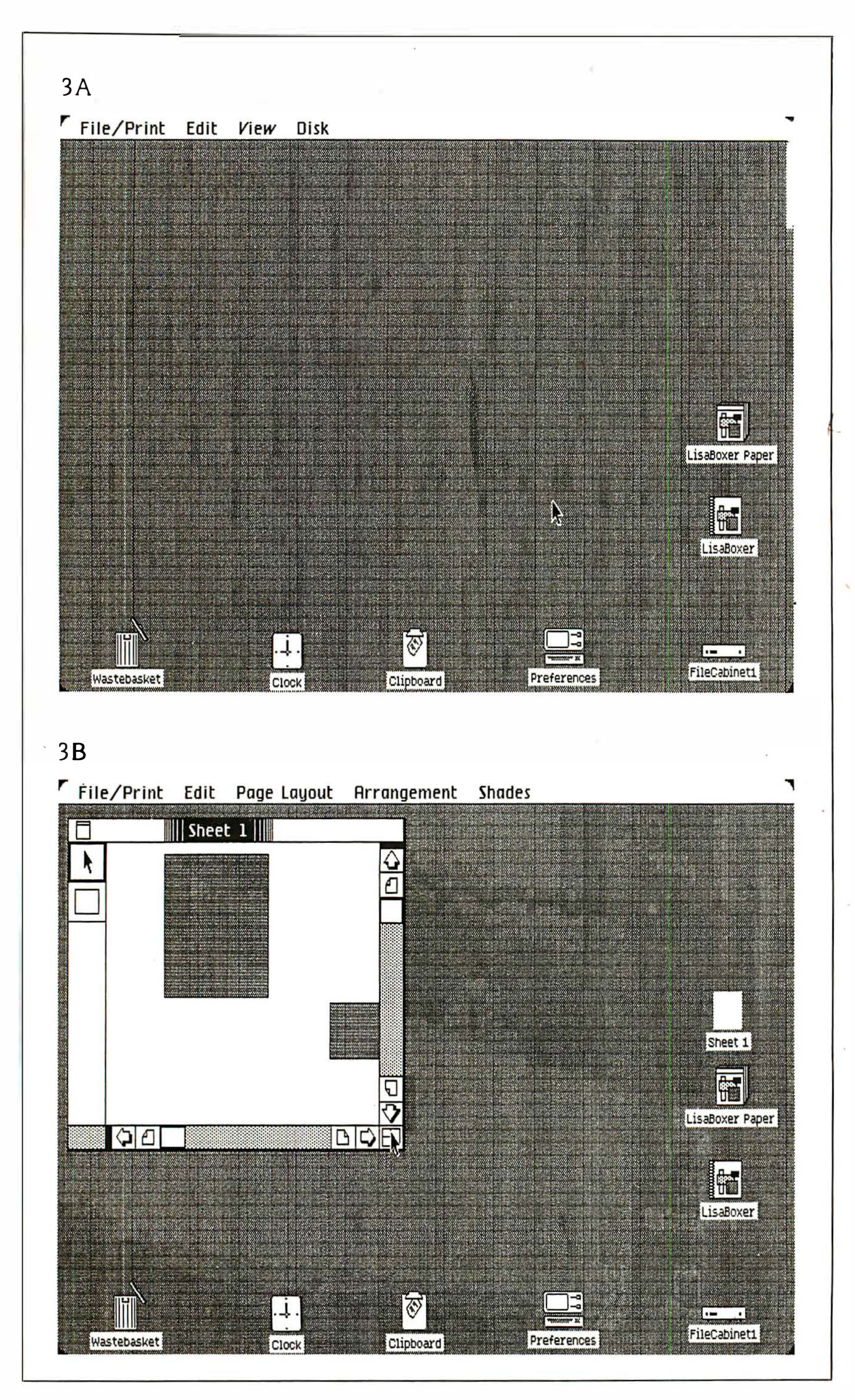


Figure 3: *How a new Toolkit/32-based application appears within the desktop environment. Once the application is linked to the Lisa Office System (figure 3a), it becomes visible on the desktop as two icons, a tool (here, Lisa Boxer) and a notepad of paper (Lisa Boxer Paper). When a sheet of paper is torn off (figure 3b), it becomes an open window used to display the application. Here, Lisa Boxer is a simple program (written in five pages of code) that puts two boxes in the window and allows you to move them arbitrarily.*

(continued from page 127)

We insert this code into the Toolkit/32 program, compile it, and link it to the Lisa Office System (the software that the Lisa runs to give the desktop-metaphor environment) under the name "Lisa Boxer." When we boot the Lisa Office System, the Lisa Boxer program appears on the desktop as a Lisa Boxer tool icon and, beneath it, a "notepad" of Lisa Boxer "paper" (see figure 3a). When we "tear off" a sheet of Lisa Boxer paper and "open" it, we get a window with two shaded boxes in it (figure 3b).

Now we can see how Toolkit/32 greatly simplifies the software developer's job. We find that we can change the size of the window, as shown in figure 4a; this default behavior results from the predefined Toolkit/32 code. We can also move either of the boxes, as shown in figure 4b; this behavior results from the code we added. If we try to do something that neither the Toolkit/32 code nor our code knows how to do (like selecting a box and giving it the "Gray" command from the Shades menu), the Toolkit/32 program recognizes its inability to execute the command and deactivates the command in the pull-down menu (the computer indicates this by printing the new selection in gray instead of black).

There are literally hundreds of events and interactions that you would have to orchestrate if you were writing a driver program for an application with a sophisticated user interface. Granted, it takes some effort to correctly integrate your code into a software framework like Toolkit/32, but you will still save a lot of lines of code you don't have to design, write, and debug.

Object-Oriented Languages

Before we can take a closer look at Apple's implementation of a software framework, we must first look at object-oriented languages. If you're familiar with the phrase, you probably associate it with the language Smalltalk, on which BYTE did a special language issue in August 1981. At the

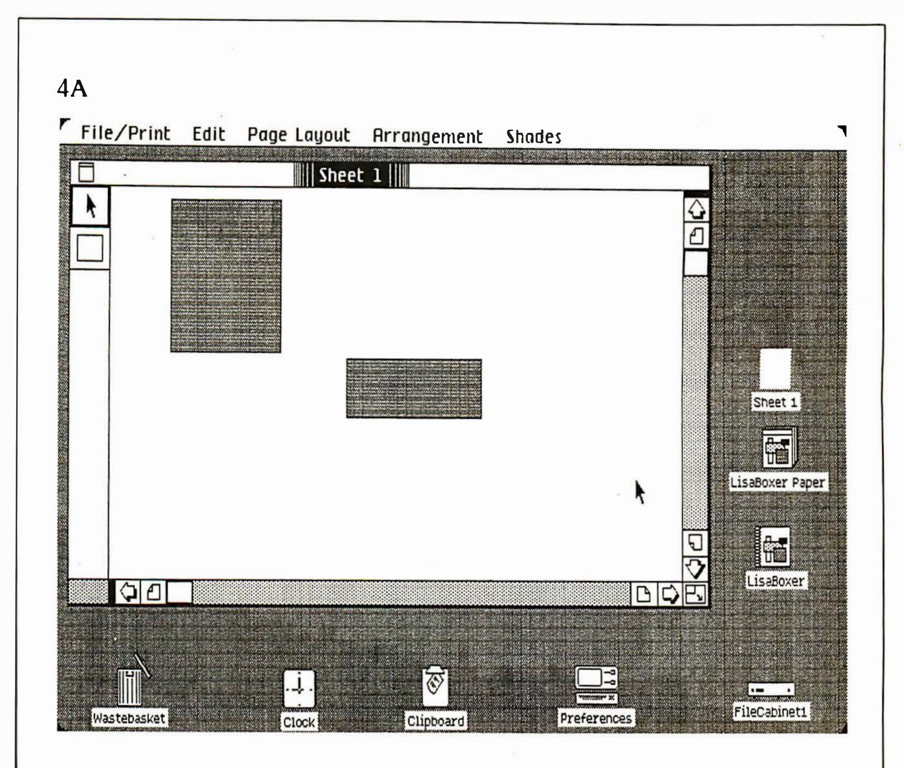
moment, Smalltalk is the best-known object-oriented language.

Most computer languages are *operator-operand languages*—that is, languages in which operators (like "+" and "/") perform predefined functions on operands (usually numbers). When we execute "5 + 3" in an operator-operand language, the operator "+" adds the operands 5 and 3. This is an orientation so widespread that most of us have trouble understanding a different one. *Object-oriented languages*, on the other hand, present the programming environment as a collection of objects that receive messages; here, when we calculate "5 + 3", the object "5" receives the message "+3" and knows what to do with it (it adds the two numbers, returning the value 8). Each object has a set of messages (called *methods*) it understands. When a message is passed to an object, the object checks the message against its list of methods. If it finds the method, it executes the associated code; if it does not find the method, it returns a message that says, "I do not understand the message 'xxx'."

Objects are grouped into classes, with the possibility that some classes may be contained within others. When this occurs, a member of a class (with some exceptions) understands not only its own methods, but also the methods of its superclass (the class that immediately contains it) and its ancestor classes (any *n*th-generation-removed superclass). (For more details, see "The Smalltalk-80 System," by members of the Xerox Learning Research Group, August 1981 BYTE, page 36.)

The object-oriented approach is too involved for an environment that manipulates numbers only, but it is very useful in environments that include different number types, windows, graphics, icons, lists, control structures, and other items. The object metaphor can encompass all these (and other) items; this simplifies the language and, therefore, makes the programmer's job easier. Also, by the careful creation of classes and subclasses, programmers can amplify

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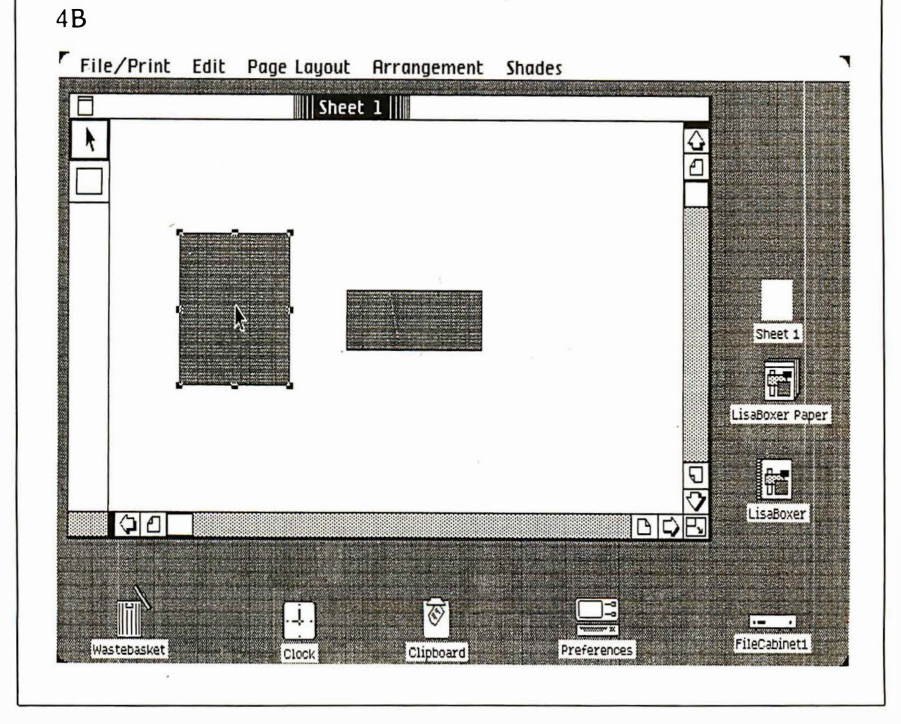


Figure 4: *Component of a Toolkit/32-based application's behavior. Behavior may be specified by the software framework (e.g., changing the size of a window, figure 4a) or the application (moving one box, figure 4b). In only the second case does the programmer have to add code to the software framework to get the desired result; see the text for details.*

their programming work by defining useful methods that can be used automatically by objects within a subclass. In this and other ways, object-oriented languages help programmers design and modify extremely large projects. As Bruce Blumberg puts it, "Object-oriented programming will be to the 1980s what structured programming was to the 1970s."

Object-oriented languages differ from operator-operand languages in two other important ways. First, the definition of a given operator in an operator-operand language is given in the code that defines that operation for all possible data types; to add a new data type to such a language, the programmer must add code to the definition of the numerous operators that will deal with that data type and add error-trapping code to all the operators that won't. In an object-oriented language, all such code is located in one place—the definition of the class—and operations that members of that class don't understand return error messages automatically. In addition, code that was previously written, when compiled with the information defining that new class, will run as is when it sends an old message (operator) to a new object (data type).

A second advantage of the object-oriented language is that it mirrors the subject-verb orientation of some user environments more closely than traditional operator-operand languages. Many software designers have found that the subject-verb orientation (i.e., selecting an item to be worked on, then choosing the action that will be performed on it) makes software easier to understand. For example, in Apple's Lisa Write, Microsoft's Word, and other word-processing programs, you can delete a phrase of text by first selecting it, then choosing the "delete" operation. You can see that the object-message orientation of an object-oriented language closely parallels the subject-verb orientation of the software itself; this strong parallelism makes the software easier to write and, later, to maintain.

Readers interested in learning more about Smalltalk as an example of an object-oriented language can refer to the August 1981 BYTE and to *Smalltalk-80: The Language and Its Implementation*, by Adele Goldberg and David Robson, Reading, MA: Addison-Wesley, 1983.

PASCAL + CLASSES = CLASCAL

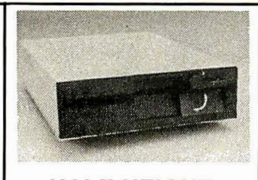
The presence of Apple's Larry Tesler in BYTE's Smalltalk issue telegraphed Apple's interest in the language (although we didn't know at the time that it was being researched in rela-

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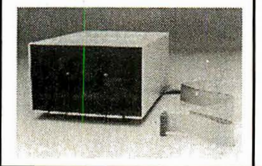
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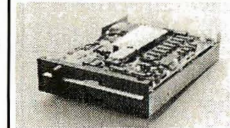


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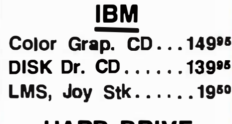
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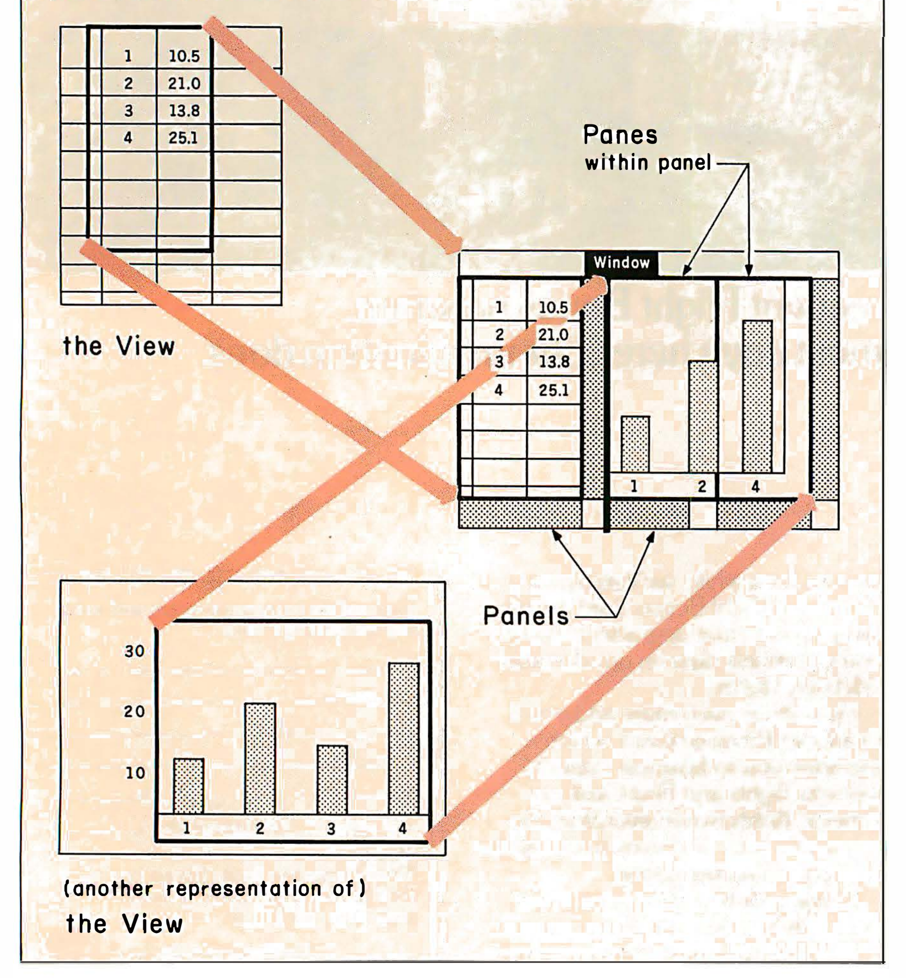
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Toolkit/32 Naming Conventions

To understand Toolkit/32, you first have to understand several terms that have specific definitions (refer to the figure below). The *window* is the object through which you manipulate data via your application program. This is the same kind of window as is advertised in several desktop-metaphor environments; its size can be changed, it can be moved to any location on the video screen, and it can be "behind" or "in front of" other windows. Underneath the application program, invisible to you, is a data structure, and the purpose of the application program is to give you one or more *views* of the data. The actual data, which is not shown, is a collection of four ordered pairs: (1,10.5), (2,21.0), (3, 13.8), (4, 25.1). The top view shows the data as a spreadsheet, and the bottom shows it as a graph, but neither is the actual data.

A window (and the application program it represents) can show more than one view. To do this, the application program divides the window into one or more *panels*. Each panel shows part of its corresponding view and can be scrolled independently from any other panel to show any arbitrary region of its view. In many cases, a panel can be broken into *panes*, each of which can be scrolled in one dimension to show different regions of the same view. (Below, note that the right pane of the right panel has been scrolled to show only the fourth bar in the bar graph.)



tion to the Lisa). Apple implemented Smalltalk for the Lisa but never released it; "It's too slow," Tesler said, "and its syntax is too different for most people." However, designers at Apple did not lose their enthusiasm for object-oriented languages, especially after they had a taste of the problems that came with the original six Lisa application programs, which were written as standard Pascal programs.

The Toolkit/32 team created Clascal, a superset of Pascal that contains a new data type: classes. By doing so, they created what they thought contained most of the familiarity of Pascal with most of the power of an object-oriented language. The class data type is like the record data type in Pascal. Just as a Pascal RECORD statement defines the record by the fields it has, a Clascal SUBCLASS statement defines a class by the fields and methods it has. Similarly, just as a record is an instance of the record definition, an object is an instance (or member) of a class. Clascal defines one class, TObject. All other classes are subclasses of TObject, and all objects have TObject as an ancestor class. Each object can respond to the methods of its class and those of all its ancestor classes; the only exception to this is that if two of the object's classes and superclasses have the same method, the object uses the one closest to it—this allows a subclass to override the (perhaps inappropriate) methods of one of its ancestor classes.

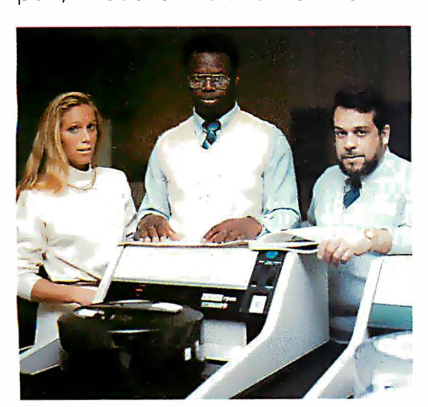
The definition of a class consists of stating the class's name, the class of which it's a direct subclass, the new fields not inherited from an ancestor class, the functions and procedures that constitute the class's methods, the algorithms that implement those methods, and (optionally) the code that must be executed when the class is created. A class inherits the methods and fields of all ancestor classes unless they are specifically redefined within the class definition. When an object of this class is created, it is associated with a set of

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values for that class's fields; you can think of a field as a private variable each object gets upon its creation.

Listing 1 shows sample code from the application that created the Lisa Boxer application program described earlier. This segment defines the methods that the objects of the TBoxView class understand—NEW, BoxWith, and Draw— and the code (under the heading CREATION) that executes when the class is created. In this example of code, methods are capitalized and fields are not, and an object and its method are joined with a period—for example, "s.Scan(box)" sends the method Scan to the object s with the object box as an argument; also, braces delineate comments that are included only to explain the surrounding code.

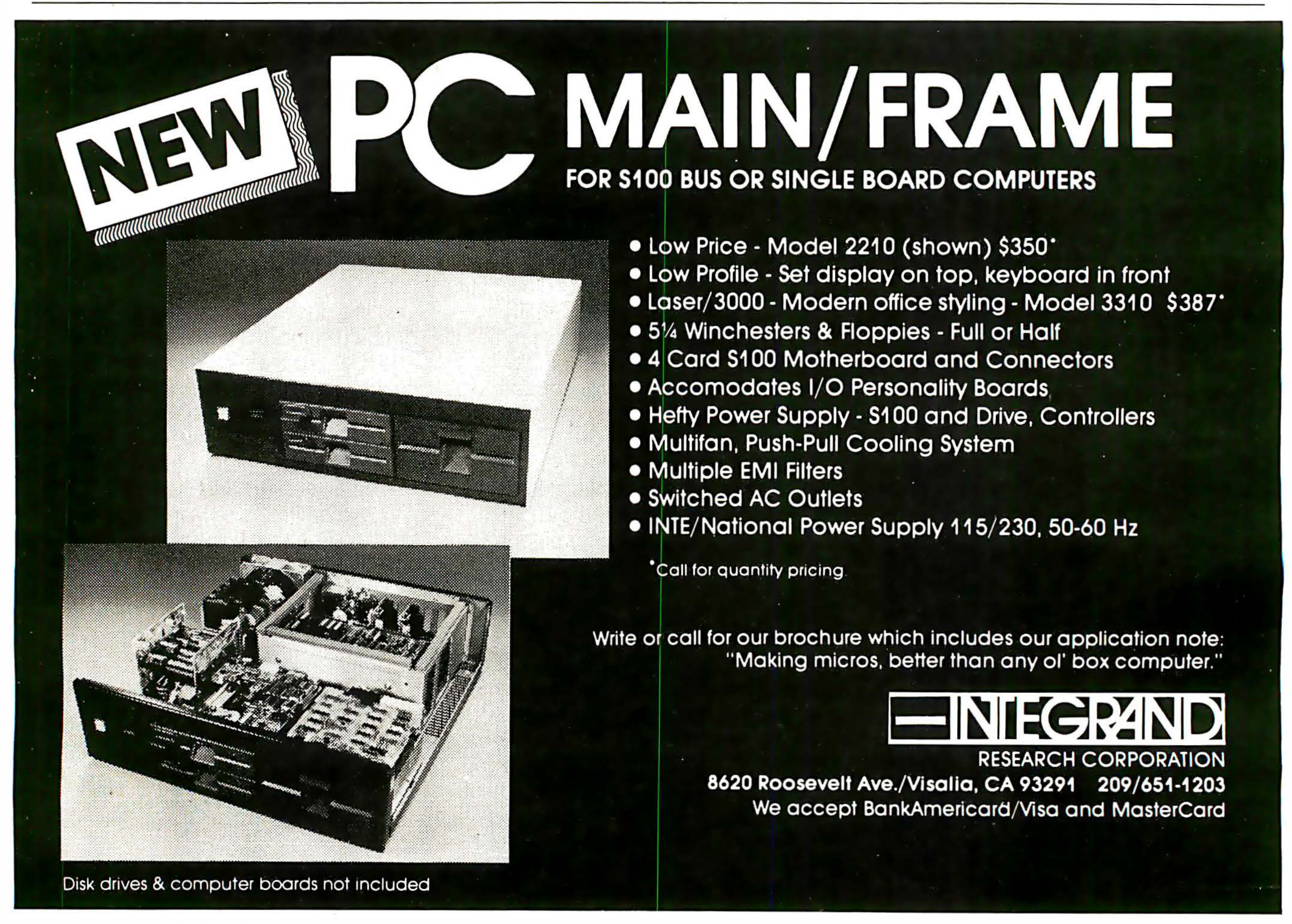
Table 1: *A partial list of tasks that are taken care of automatically by the Standard Application within Apple's Toolbox/32. Software frameworks present a prepackaged solution to the complicated problem of creating an event-driven, window-based user environment; as such, they decrease the programmer's work by one to two orders of magnitude, thus allowing him or her to create a software application much faster and with a smaller time commitment.*

memory management
file management
printing and other I/O
communication with the desktop environment
communication with the clipboard (allows different applications to exchange data)
creation, deletion, activation, deactivation, and size and position change of windows
multiple panes within a panel
multiple panels (giving differing views of the data)
standard scrolling within a pane or panel
handling of all errors not dealt with by user code
passing of system events (e.g., mouse movement, keypresses) that the Standard Application cannot handle to user code

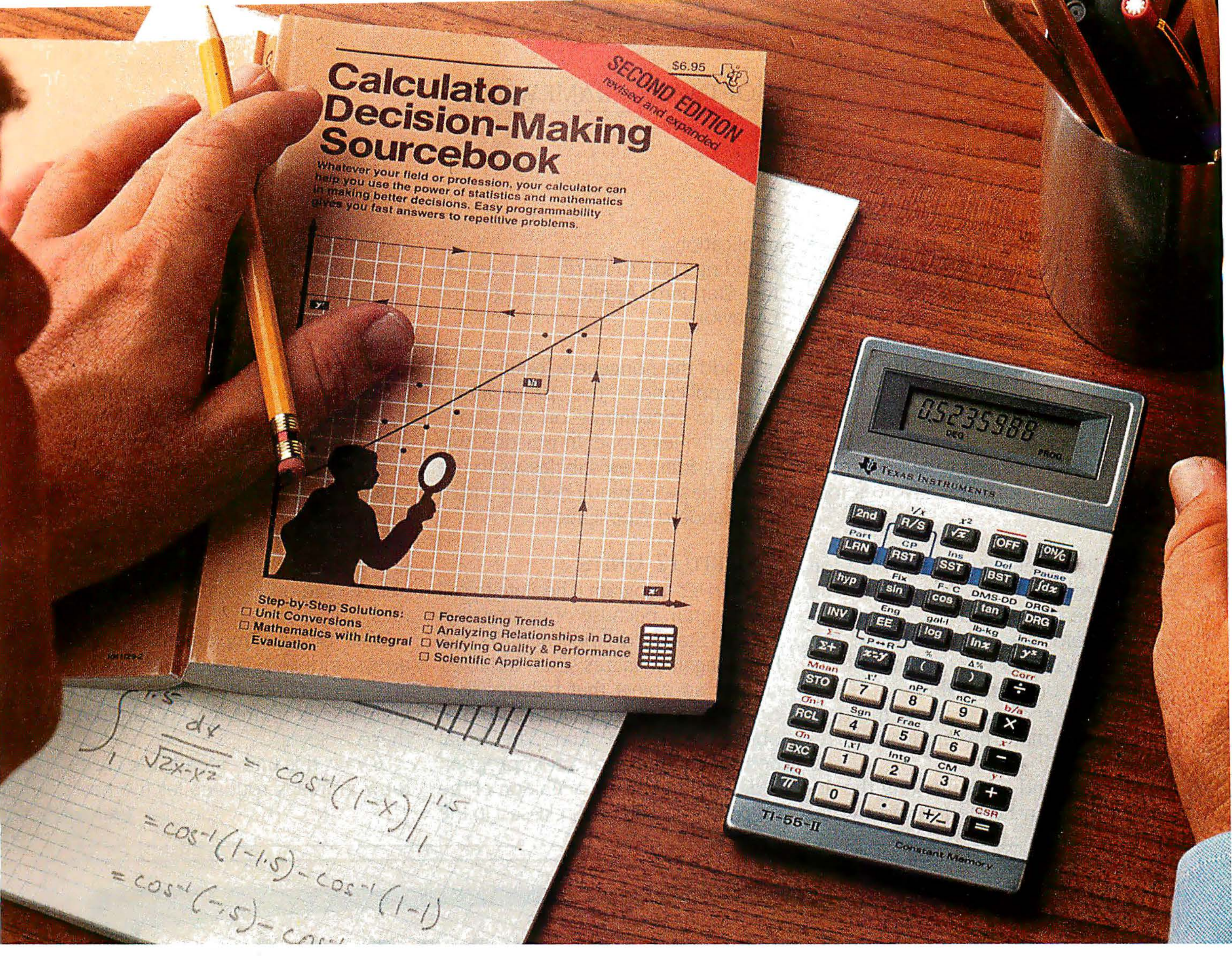
INTERFACING TO THE STANDARD

Now we can examine the Standard Application in more detail. The Standard Application is a collection of classes that implement the generic behavior of a standard Lisa application program—that is, all the actions that, because of the previously de-

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fined user interface, are the same from program to program. Table 1 lists some of the functions that are handled automatically by the Standard Application. This means that programmers who are modifying the Standard Application must provide only code that implements the behavior specific to their applications (this will be referred to later as nongeneric behavior). This involves four activities:

- supplying the Standard Application code with the view or views of the data when requested (for a definition of the word "view" in this context, see the text box "Toolkit/32 Naming Conventions" on page 398)
- creating and maintaining the data structures that the application requires
- defining and implementing the actions that can be performed by the application
- adding code to modify or override the Standard Application's generic behavior

To add the nongeneric behavior of the application, the programmer needs to concentrate on the above four activities alone. In practice, this means adding new subclasses to the object classes already defined within the Standard Application.

TOOLKIT/32 UNITS

The "driver" program (I hesitate to call it a program because of its triviality) for the Standard Application is five lines long; it initializes some variables, creates an object that belongs to a class called "process," and sends that object the method "Run." The actual behavior of the application program is determined by the definition of the process class and other classes. In the following paragraphs, I will take a look at the major units that make up the Standard Application. (The units I refer to here are like Pascal units; the units below each contain related subclass definitions.)

UObject: the UObject unit defines the class TObject, the universal ancestor class of all Clascal objects. This unit handles memory allocation for objects (they are given memory when they are created, and the memory is reclaimed when they are deleted); it also handles object copying and enables some optional debugging facilities.

UList: this unit implements dynamic arrays, indexed, linked, and blocked lists, and utilities that allow the programmer to create, modify, and scan these objects.

UDraw: this unit extends the Quickdraw graphics routines (at the heart

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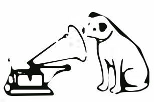
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of Lisa's graphics capabilities) to use 32-bit coordinates instead of Quickdraw's 16-bit coordinates; this eliminates possible document-size problems that could arise from using 16-bit coordinates. UDraw is used for drawing in a view.

UABC: the "ABC" stands for application-base classes. UABC contains most of the classes that define the standard behavior. Because of this, programmers will spend most of their time creating subclasses of UABC to implement the application's nongeneric behavior.

INSIDE UABC

We will now take a brief look at which classes within UABC are usually modified and how those modifications create the application program's nongeneric behavior.

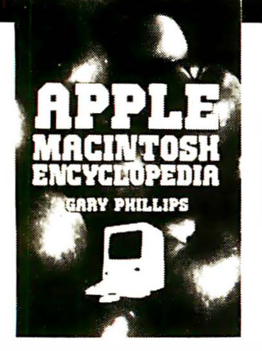
The methods of the TProcess class are those methods (or actions) that are specific to the application but are called every time the application executes. Every Toolkit/32 application creates only one process object, which implements the main program loop of the application. An application almost always follows this loop: get an event (e.g., menu selection, mouse movement, keypresses), process it by giving it to an object that understands what to do with it, and wait for the next event. The process object also handles error and warning messages and the procedure for ending the application.

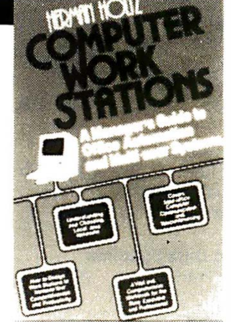
An application creates one object from the ancestor class TDocManager for each document icon or open window that is associated with the application. This descendant object controls the interface to all disk files that define the document, and it manages the memory used by the document.

Objects descended from the TView class define any views needed by the application—one object for each view the application uses. The view shows the entire representation of the application's data, interpreted as the view is defined to show it. A panel object (described below) asks a view object for the view, but it is the panel object's responsibility to draw the part that is to be visible (this is one of the things the Standard Application code usually does automatically). Obviously, one of the programmer's main responsibilities is to create the code that implements the view.

Whenever the user selects an action to be performed (usually by choosing a selection from a pull-down menu), the application creates an object that is a descendant of the TCommand class and gives it the message "Perform," which causes the object to try to execute itself. Most actions should

(continued)





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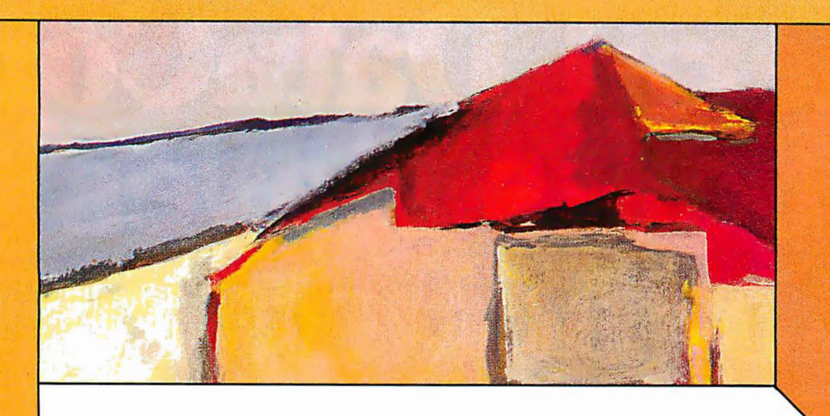


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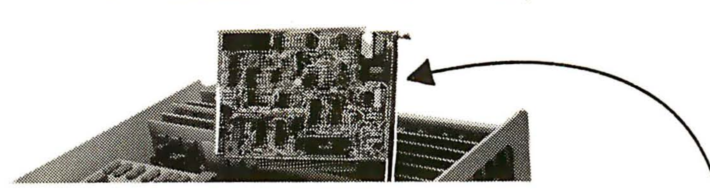
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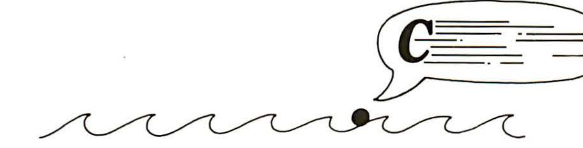


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TWindow, TPanel, and TPane are classes that define the behavior of windows, panels, and panes.

be implemented so that they first change the view but not the underlying data; this allows the "Undo" message to work in most cases. If "Undo" is not the next message sent, the program automatically executes a method called "Commit," which makes the changes already shown in the view to the data itself. Each panel of the application has an object descended from the TSelection class; this selection object can handle messages and manipulate whatever objects, if any, are associated with that panel. When a command object executes itself, it gives itself to the selection object associated with the active panel.

TWindow, TPanel, and TPane are classes that define the behavior of windows, panels, and panes. Their behavior, already defined by the Standard Application, does not usually need to be changed by the programmer; each panel will ask a view object for the view and will display the appropriate part as part of its generic behavior.

Commentary

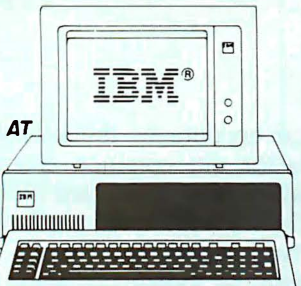
The software framework approach is an extremely useful one for programmers who want to develop sophisticated applications but who don't have the resources (or patience) to write the extremely complicated code that will bring it up in an interactive user environment. The Apple Lisa group has developed the Toolkit/32 system described in this article. The Microsoft "window" device under MS-DOS 2.0 works similarly for MS-DOS-based software. (According to Scott McGregor of Microsoft, his company has developed a "Microsoft Windows Toolkit" for software developers that

(continued)

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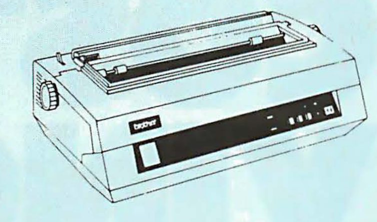
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is "identical in concept to Toolkit/32"; however, details of this were not available when this was written.)

Clascal shows great promise for extending programmer productivity when used in large projects. One question comes to mind, though: Is the software it creates fast enough? Bruce Blumberg of Apple Computer said that Clascal is "about 10 times faster than Smalltalk and only 10 percent slower than Pascal." Given that the original Lisa applications were written in Pascal and that the recently released enhanced packages added some machine-language code to speed them up, the above statement is of little comfort. We'd all better wait until the first Toolkit/32-based application programs can be examined before forming a final opinion on Clascal.

I must add to this enthusiastic description of Toolkit/32 the fact that, although it saves the programmer tremendous amounts of time, the Clascal class orientation does take some getting used to. Although a novice Clascal programmer takes about a month, according to Apple, to begin to understand Clascal well enough to take advantage of it, it still saves time in the long run to develop Toolkit/32-based application programs.

To conclude, I must make two sets of observations. First, the software framework orientation represents a subtle but important change in how we look at developing an application program—in changing the programmer's task from writing a program to writing subroutines, it clearly delineates the program's generic behavior from the nongeneric and allows the programmer to concentrate on the latter. Second, Toolkit/32 implements the software framework in an interesting and powerful way. Clascal encourages the programmer to factor out common characteristics, which are embodied in high-level classes from which much code is derived. Apple has already done this with the Toolkit/32's Standard Application code, thus allowing the programmer to write code that inherits a lot of structure and power from the previously defined ancestor classes. In any case, software frameworks may be one answer to the problem of creating sophisticated programs quickly and inexpensively. ■

[Editor's note: As this article was going to press, Larry Tesler of Apple told us that the Toolkit/32 product was being made available to any Lisa owner (for details, write to the Software Resource Center, Mail Stop 2-P, Apple Computer, 20525 Mariani Ave., Cupertino, CA 95014). In addition, Apple is considering creating a similar product for use by Macintosh software developers.]

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FX-80 WORDSTAR SUPERSCRIPTS

BY MICHAEL H. GOLDBAUM

SCIENTIFIC ARTICLES and other documents often require the use of superscripts or subscripts. The popular WordStar program, when used with the Epson FX-80 dot-matrix printer, ordinarily cannot use the superscript and subscript print modes (see reference 1), though it is possible to patch WordStar to generate these modes in the PC-DOS operating system (see reference 2).

There is, however, a simple method to produce superscript and subscript printing on the FX-80 without patching the WordStar program. Further, in this method, the WordStar commands work in standard fashion, and the printed characters are displaced upward or downward as they would be with a daisy-wheel or thimble printer.

Under ordinary circumstances of printing with the FX-80, the WordStar commands ^T (for superscript) or ^V (for subscript) do not function properly. That is, if the line containing the toggles is "boxed in" with other lines immediately above and below (as in a single-spaced block of text), the superscripting and subscripting will not occur. On the other hand, if there is no line above or below the line containing these commands, superscripts are displaced upward a full line, and subscripts are displaced downward a full line. Neither of these modes of behavior is particularly satisfactory. But you can use the characteristics of the latter to trick the Epson printer into producing single-spaced text while

(continued)

Michael H. Goldbaum, M.D. (225 Dickinson St., H898, San Diego, CA 92103), is associate professor of ophthalmology at the University of California and Veterans Administration Medical Center.

Table 1: *WordStar dot-command alterations. The left margin (^OL), right margin (^OR), and page offset (.PO) need not change.*

	Dot Command	Default Setting	New Setting
.PL	Paper length	66 lines	198 (66 × 3)
.MT	Margin at top	3 lines	0 (printing starts 1 inch below top)
.MB	Margin at bottom	8 lines	33 ((8 + 3) × 3)
.FM	Footing margin	2 lines	6 (2 × 3).

Table 2: *If you use headings, you should make room for the heading line by altering the dot command as shown below.*

	Dot Command	Default Setting	New Setting
.PL	Paper length	66 lines	198
.MT	Margin at top	3 lines	6 ((3 − 1) × 3)
.MB	Margin at bottom	8 lines	27 ((8 + 1) × 3)
.HM	Heading margin	2 lines	6 (2 × 3)
.FM	Footing margin	2 lines	6 (2 × 3).

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Unix* Bell Laboratories.
CP/M* Digital Research Corp.

it perceives the text as being triple-spaced. The superscript and subscript commands will displace the enclosed characters one-third line space up or down, respectively. You accomplish this by setting the WordStar program to triple space and setting the Epson printer to one-third line space.

WORDSTAR SETTINGS

For ease of entry and editing, you can type in your text in the normal format. When you've completed the document, set the line spacing at ^OS3 and reformat each paragraph with the command ^B. You will need to add two line spaces (^N) between paragraphs to maintain triple space between paragraphs. Also, the default settings of the dot commands for paper length and margins will not produce the proper page format, so you must place dot commands at the beginning of the document to triple the default values and to compensate for the Epson FX-80 starting one inch from the top of the page (table 1).

EPSON FX-80 SETTINGS

The line spacing for the FX-80 is set by means of an ESC A sequence in BASIC and is expressed in multiples of 1/72 inch. The default line spacing is 6 lines per inch. Each line is thus 1/6 inch, to an actual setting of 12/72. We want the new line spacing to be 1/3 the normal, or 18 lines per inch, for a new setting of 4/72. So, prior to printing, reset the spacing with the following BASIC sequence (ESC A line space setting for $n/72$ where $n=4$):

```
10 LPRINT CHR$(27);"A";CHR$(4);
```

This combination of triple-spaced text formatting and 18-lines-per-inch printing produces output of 6 lines per inch (single space) with superscript and subscript appropriately displaced. ■

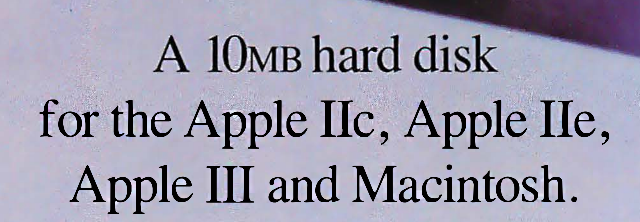
REFERENCES

1. Stevenson, Charles. "Does Your Printer Work with WordStar?" BYTE, September 1983, page 411.
2. Wallace, Neil G. "Full Use of the Epson MX-80 Under WordStar." BYTE, May 1983, page 203.

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THE AI BUSINESS, Patrick H. Winston and Karen A. Prendergast, eds. Cambridge, MA: The MIT Press, 1984; 336 pages, 15.8 by 23.5 cm, hardcover, ISBN 0-262-23117-4, $15.95.

THE APPLE IIc BOOK, Bill O'Brien. New York: Bantam Books, 1984; 288 pages, 15.3 by 22.8 cm, softcover, ISBN 0-553-34149-9, $12.95.

APPLE IIc USER GUIDE, Gary Phillips and Donald Scellato. Bowie, MD: Brady Communications Co., 1984; 384 pages, 17.8 by 23.5 cm, softcover, ISBN 0-89303-307-3, $14.95.

APPROACHES TO PROTOTYPING, R. Budde, K. Kuhlenkamp, L. Mathiassen, and H. Züllighoven, eds. New York: Springer-Verlag, 1984; 470 pages, 16.8 by 24.3 cm, softcover, ISBN 0-387-13490-5, $23.

THE ART OF COMPUTER CONVERSATION, Brian R. Gaines and Mildred L. G. Shaw. Englewood Cliffs, NJ: Prentice-Hall, 1984; 224 pages, 17.5 by 23.3 cm, softcover, ISBN 0-13-047332-4, $16.95.

BABBAGE'S CALCULATING ENGINES, Volume 2 in the Charles Babbage Institute Reprint Series for the History of Computing, Henry Prevost Babbage. Los Angeles and San Francisco, CA: Tomash Publishers, 1982; 402 pages, 22.3 by 28.5 cm, hardcover, ISBN 0-938228-04-8, $45.

BASIC PROGRAMMING FOR THE VAX AND PDP-11, George Diehr, Terry Barron, and Thomas Munro. New York: John Wiley & Sons, 1984; 494 pages, 21.3 by 27.8 cm, softcover, ISBN 0-471-86817-5, $19.95.

BEGINNING MICRO-PROLOG, 2nd revised ed., Richard Ennals. New York: Harper & Row, 1984; 208 pages, 18.5 by 23.5 cm, softcover, ISBN 0-06-669000-5, $15.95.

THE BEST OF COMMODORE 64 SOFTWARE, Thomas Blackadar. Berkeley, CA: Sybex, 1984; 192 pages, 15 by 22.8 cm, softcover, ISBN 0-89588-194-2, $12.95.

THE BEST OF CP/M SOFTWARE, John D. Halamka. Berkeley, CA: Sybex, 1984; 272 pages, 17.5 by 22.8 cm, softcover, ISBN 0-89588-100-4, $14.95.

THE BEST OF IBM PC SOFTWARE, Stanley R. Trost. Berkeley, CA: Sybex, 1984; 382 pages, 17.8 by 22.8 cm, softcover, ISBN 0-89588-104-7, $16.95.

BETTER RÉSUMÉS FOR COMPUTER PERSONNEL, Adele Lewis and Berl Hartman. Woodbury, NY: Barron's, 1984; 224 pages, 19.8 by 27.8 cm, softcover, ISBN 0-8120-2860-0, $6.95.

BRAIN TICKLERS, Apple II/IIe ed., Mark A. Spikell and Stephen L. Snover. Englewood Cliffs, NJ: Prentice-Hall, 1983; 192 pages, 17.3 by 23.3 cm, 3-ring binder, ISBN 0-13-081026-6, $39.95. (Includes *Mathematical Problem-Solving with the Microcomputer* and floppy disk for both books.)

BUSINESS GRAPHICS FOR THE IBM PC, Nelson Ford. Berkeley, CA: Sybex, 1984; 288 pages, 17.8 by 22.8 cm, softcover, ISBN 0-89588-124-1, $18.95.

THE COMING COMPUTER INDUSTRY SHAKEOUT, Stephen T. McClellan. New York: John Wiley & Sons, 1984; 368 pages, 16.8 by 24.3 cm, hardcover, ISBN 0-471-88063-9, $19.95.

THE COMMODORE 64 MUSIC MASTER, James Vogel and Nevin B. Scrimshaw. Cambridge, MA: Birkhäuser Boston, 1983; 144 pages, 15.3 by 23.5 cm, softcover, ISBN 0-8176-3179-8, $29.95. (Includes cassette.)

COMPAQ USER'S HANDBOOK, Staff of Weber Systems Inc. Cleveland, OH: Weber Systems, 1984; 352 pages, 15 by 22.8 cm, softcover, ISBN 0-938862-11-1, $15.95.

THE COMPLEAT APPLE CP/M, Steven Frankel. Reston, VA: Reston Publishing, 1984; 256 pages, 17.3 by 23.3 cm, softcover, ISBN 0-8359-0800-3, $15.95.

THE COMPLETE SOFTWARE MARKETPLACE, Roger Hoffman. New York: Warner Books, 1984; 256 pages, 20.5 by 23.3 cm, softcover, ISBN 0-446-38024-5, $17.95.

THE COMPUTER DATA AND DATABASE SOURCE BOOK, Matthew Lesko. New York: Avon Books, 1984; 944 pages, 15 by 22.5 cm, softcover, ISBN 0-380-86942-X, $14.95.

COMPUTER OLYMPICS, Stephen Manes and Paul Somerson. New York: Scholastic, 1984; 174 pages, 20.3 by 27.8 cm, softcover, ISBN 0-590-33176-0, $4.95.

COMPUTER OPTIMIZATION TECHNIQUES, revised ed., William C. Conley. Princeton, NJ:Petrocelli Books, 1984; 256 pages, 16.3 by 24 cm, hardcover, ISBN 0-89433-213-9, $29.95.

COMPUTERS—NEW OPPORTUNITIES FOR THE DISABLED, Harold Remmes. New York: Pilot Books, 1984; 32 pages, 14 by 21.5 cm, softcover, ISBN 0-87576-114-3, $3.50.

COORDINATED COMPUTING, Robert E. Filman and Daniel P. Friedman. New York: McGraw-Hill, 1984; 276 pages, 17 by 24 cm, hardcover, ISBN 0-07-022439-0, $32.95.

CREATIVE BUSINESS APPLICATIONS WITH DBASE II, Nelson T. Dinerstein. Glenview, IL: Scott, Foresman and Co., 1984; 158 pages, 19 by 23.5 cm, softcover, ISBN 0-673-15957-4, $15.95.

A CRITIC'S GUIDE TO SOFTWARE FOR IBM PC AND PC-COMPATIBLE COMPUTERS, 1984 Update, Phillip I. Good. Radnor, PA: Chilton Book Co., 1984; 310 pages, 18.3 by 22.8 cm, softcover, ISBN 0-8019-7538-7, $14.95.

DIGITAL SIGNAL PROCESSING SOFTWARE, L. Robert Morris. Ottawa, Canada: Digital Signal Processing Software Inc., 1984; 500 pages, 22 by 28 cm, spiral-bound, ISBN 0-9691375-0-8, $249. (Includes floppy disk.)

EASY PROGRAMMING WITH THE TI-99/4A, Richard Guenette and James Vogel. Cambridge, MA: Softext, 1984; 208 pages, 16 by 23.3 cm, softcover, ISBN 0-8176-3175-5, $24.95. (Includes cassette.)

EASYWRITER II SYSTEM MADE EASY-ER, Leo J. Scanlon. Englewood Cliffs, NJ: Prentice-Hall, 1984; 144 pages, 18.3 by 24 cm, hardcover, ISBN 0-13-223587-0, $12.95.

FEEDBACK SHIFT REGISTERS, Christian Ronse. Lecture Notes in Computer Science #169. New York: Springer-Verlag, 1984; 146 pages, 16.5 by 24.3 cm, softcover, ISBN 0-387-13330-5, $9.

FIRE IN THE VALLEY: THE MAKING OF THE PERSONAL COMPUTER, Paul Freiberger and Michael Swaine. Berkeley, CA: Osborne/

(continued)

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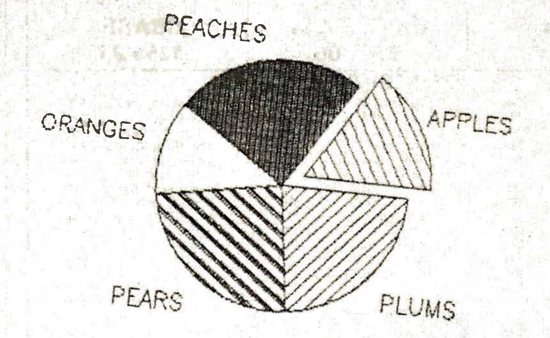
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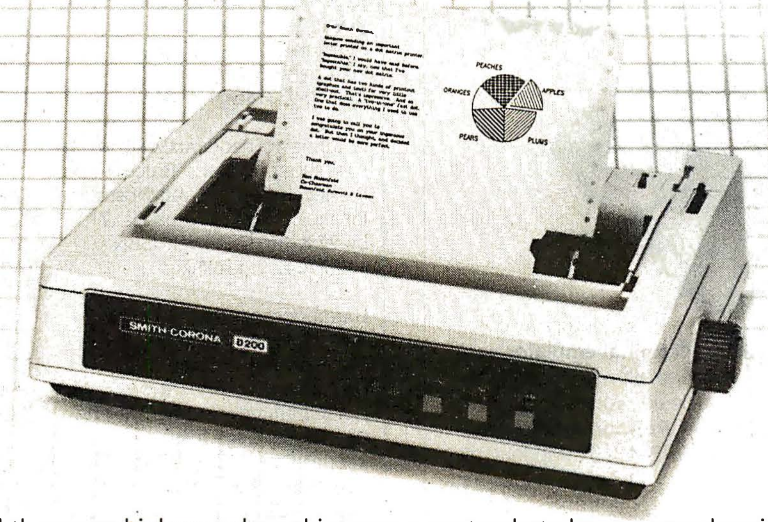
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GETTING ON-LINE, M. David Stone. Englewood Cliffs, NJ: Prentice-Hall, 1984; 320 pages, 17.3 by 23.3 cm, softcover, ISBN 0-13-354408-7, $14.95.

GETTING STARTED WITH THE IBM PC AND XT, David Arnold and the editors of *PC World*. New York: Simon & Schuster, 1984; 204 pages, 19 by 23.5 cm, softcover, ISBN 0-671-49277-2, $14.95.

GRAPHICS FOR THE COMMODORE 64 COMPUTER, Jeff Knapp. Englewood Cliffs, NJ: Prentice-Hall, 1984; 144 pages, 17.3 by 23.3 cm, softcover, ISBN 0-13-363102-8, $24.95. (Includes floppy disk.)

GUIDE TO LEARNING, RESOURCES FOR USERS OF IBM PERSONAL COMPUTERS, Beverly Hunter, LeRoy Finkel, Hal Hunter, Fred Jennes, Greg Kearsley, Barry Keesan, and Mike Mashell. Boca Raton, FL: International Business Machines, 1984; 382 pages, 20.3 by 20.3 cm, softcover, ISBN 0-933186-05-3, $4.95.

A GUIDE TO PROGRAMMING IN APPLESOFT, 2nd ed., Bruce Presley. New York: Van Nostrand Reinhold, 1984; 252 pages, 21.5 by 27.8 cm, softcover, ISBN 0-442-27249-9, $16.50.

HANDBOOK OF THE NAPIER TERCENTENARY CELEBRATION OR MODERN INSTRUMENTS AND METHODS OF CALCULATION, E. M. Horsburgh, ed. Volume 3 in the Charles Babbage Institute Reprint Series for the History of Computing, Los Angeles and San Francisco, CA: Tomash Publishers, 1982; 392 pages, 20.3 by 28.5 cm, hardcover, ISBN 0-938228-10-2, $42.

HIGH-SPEED COMPUTATION, Janvsz S. Kowalik, ed. New York: Springer-Verlag, 1984; 448 pages, 17 by 24.8 cm, hardcover, ISBN 0-387-12885-9, $46.60.

HIGH-SPEED COMPUTING DEVICES, Engineering Research Associates Inc. Los Angeles and San Francisco, CA: Tomash Publishers, 1983; 496 pages, 16 by 23.5 cm, hardcover, ISBN 0-938228-02-1, $38.

HOW TO BUY AN IBM PC OR COMPATIBLE COMPUTER, Danny Goodman and the editors of *PC World*. New York: Simon & Schuster, 1984; 224 pages, 19 by 23.5 cm, softcover, ISBN 0-671-49282-9, $14.95.

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HOW TO WRITE PICTURE PROGRAMS FOR THE COMMODORE 64, Robert J. Traister. Englewood Cliffs, NJ: Prentice-Hall, 1984; 110 pages, 17.5 by 23.3 cm, softcover, ISBN 0-13-441544-2, $11.95.

HOW TO WRITE PICTURE PROGRAMS FOR THE COMMODORE VIC-20, Robert J. Traister. Englewood Cliffs, NJ: Prentice-Hall, 1984; 112 pages, 17.5 by 23.3 cm, softcover, ISBN 0-13-441536-1, $11.95.

INSIDE APPLE'S PRODOS, John Campbell. Reston, VA: Reston Publishing, 1984; 320 pages, 17.5 by 23.3 cm, softcover, ISBN 0-8359-3078-5, $16.95.

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AN INTRODUCTION TO THE COMMODORE 64, Nevin B. Scrimshaw and James Vogel. Cambridge, MA: Birkhäuser Boston, 1984;

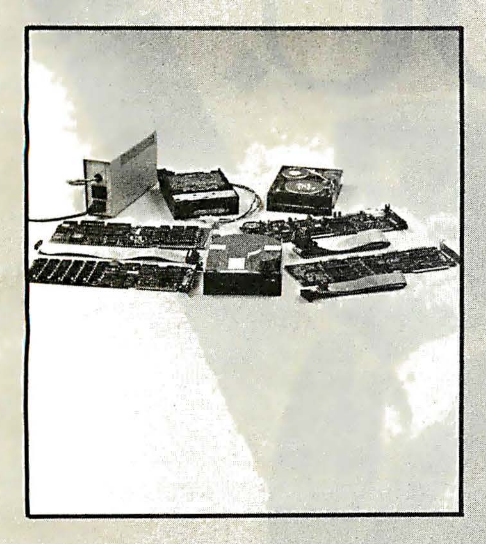
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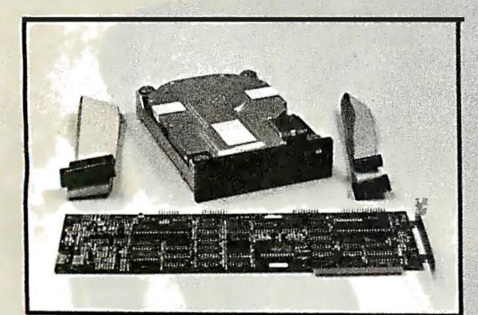
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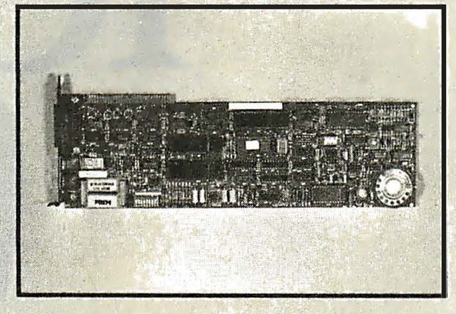


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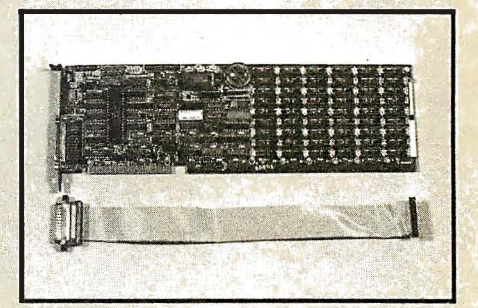
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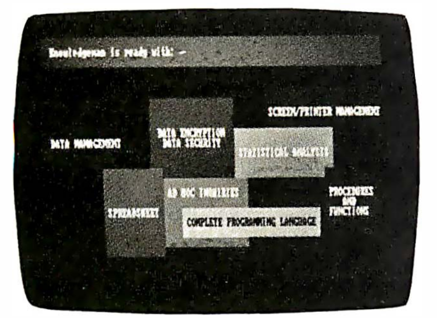
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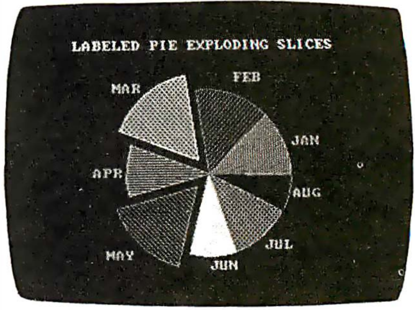
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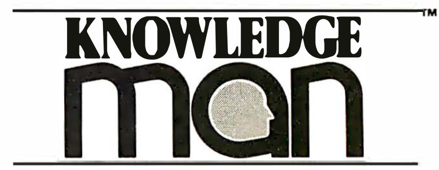


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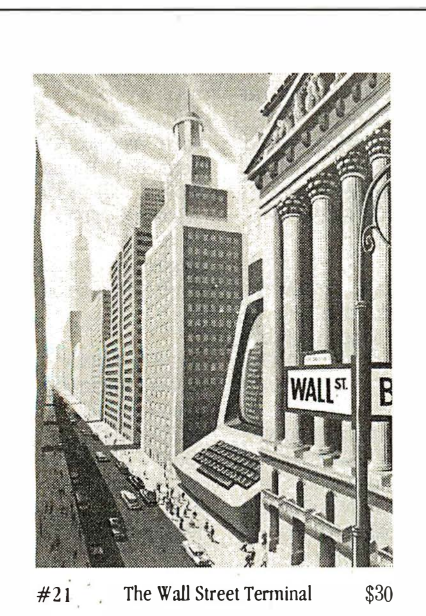
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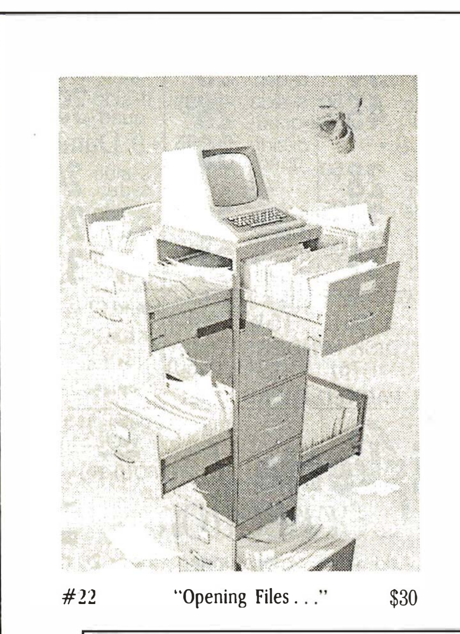
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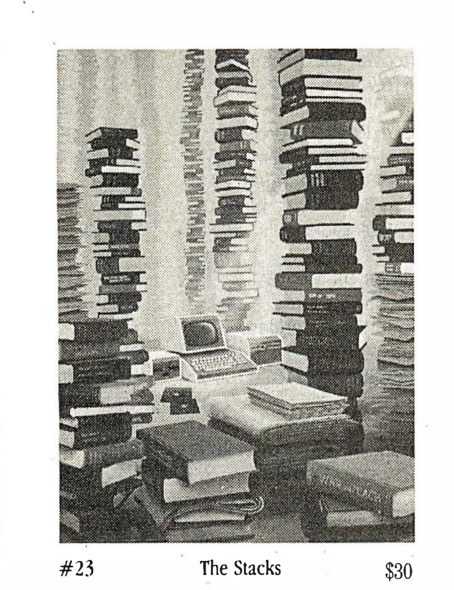
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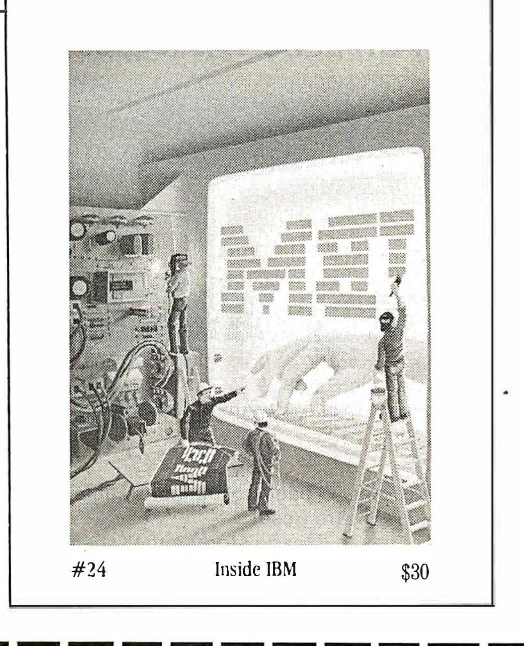
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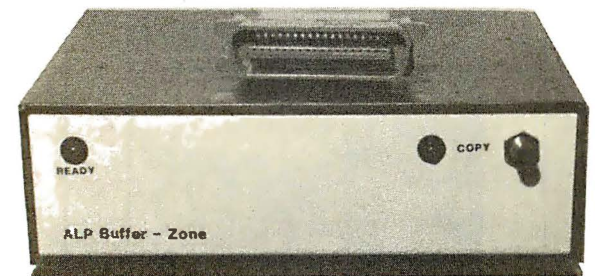
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7TH INTERNATIONAL CONFERENCE ON AUTOMATED DEDUCTION, R. E. Shostak, ed. Lecture Notes in Computer Science #170. New York: Springer-Verlag, 1984; 518 pages, 15.5 by 23.3 cm, softcover, ISBN 0-387-96022-8, $22.50.

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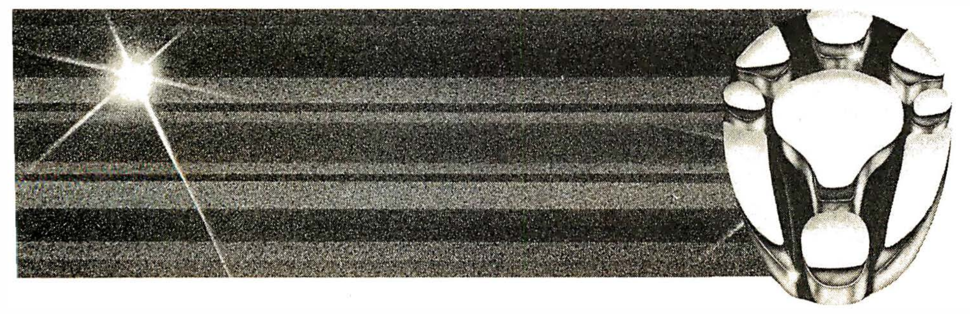
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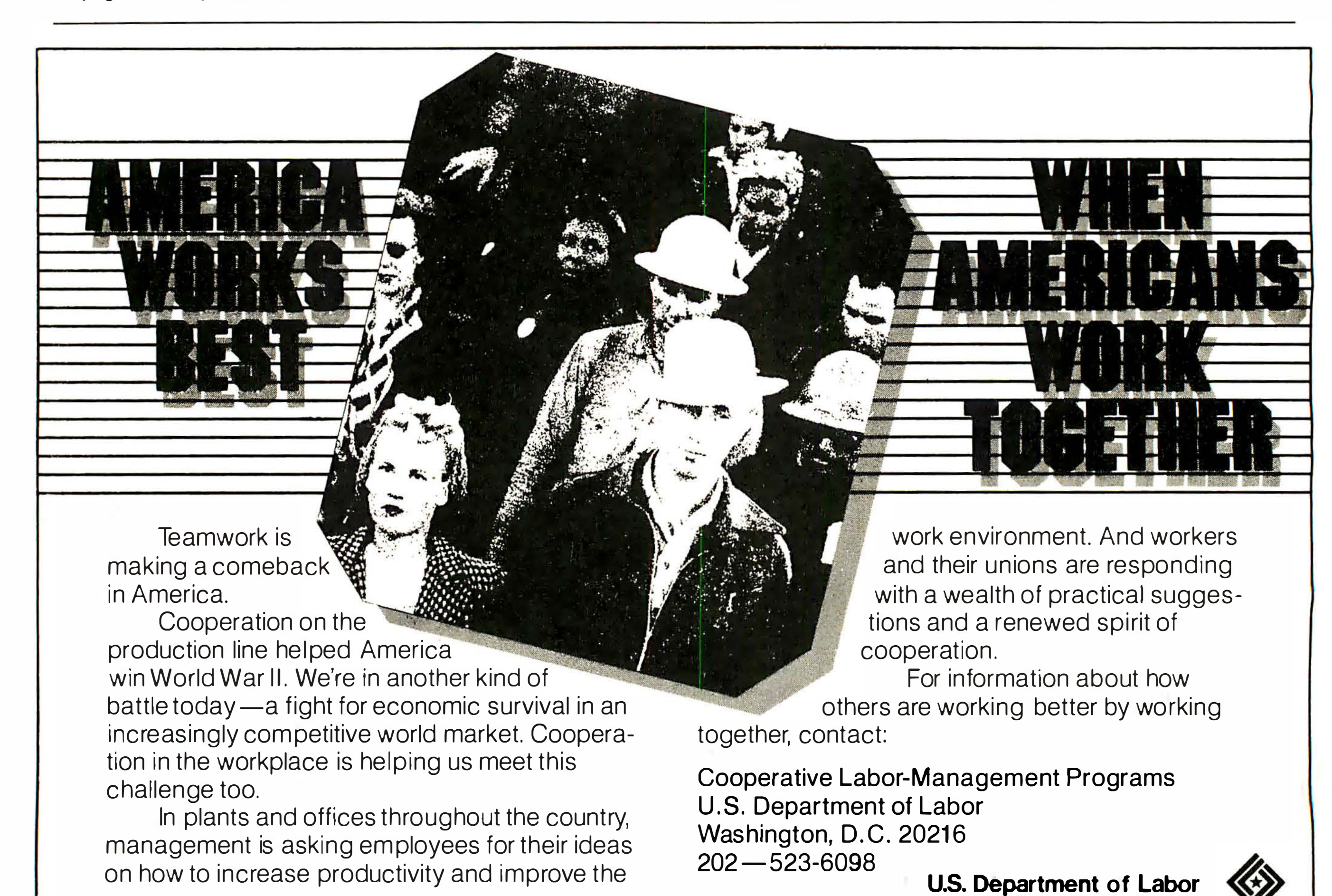
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WHAT IF? A USER'S GUIDE TO SPREADSHEETS ON THE IBM PC, Andrew T. Williams. New York: John Wiley & Sons, 1984; 296 pages, 17 by 25.3 cm, softcover, ISBN 0-471-89218-1, $16.95.

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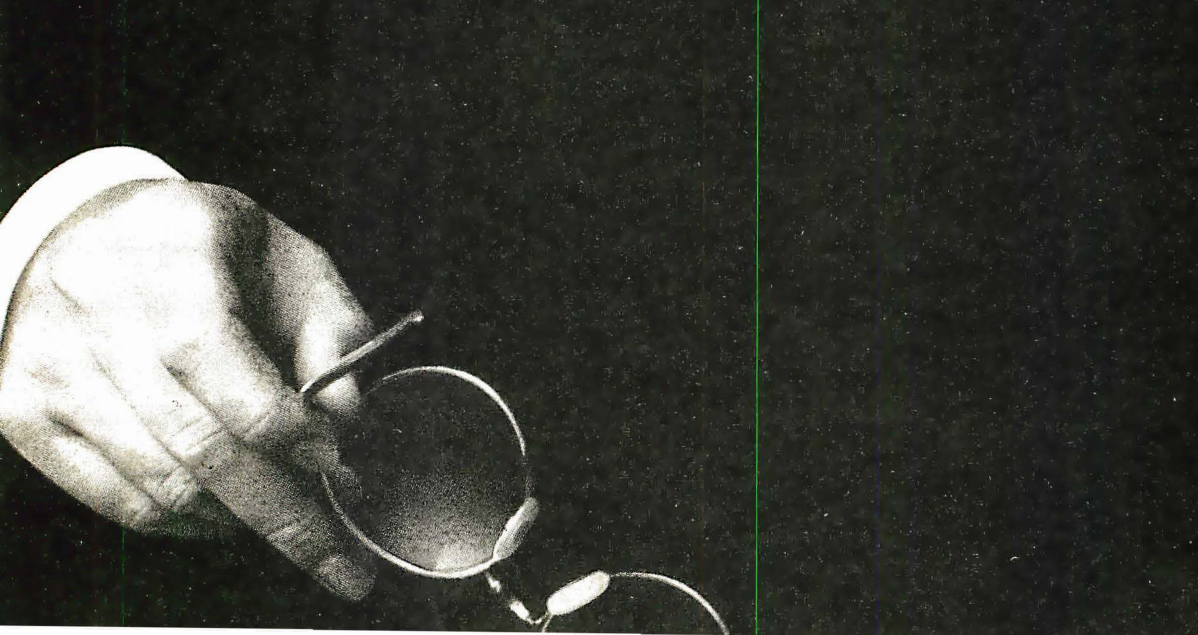
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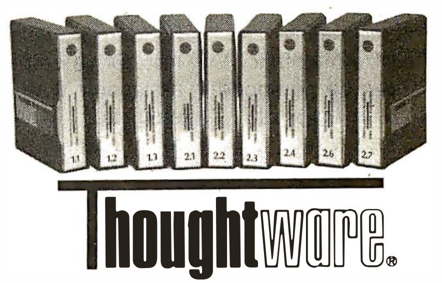
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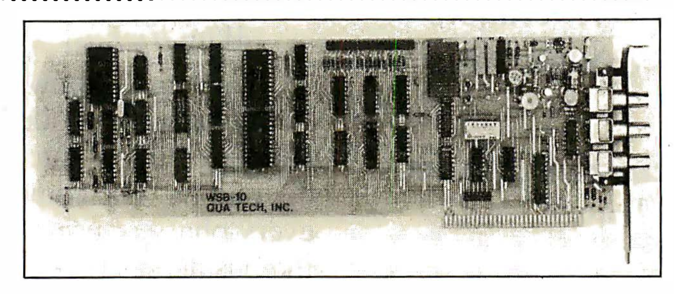
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ADD-INS

Arbitrary Waveform Generator for PC

Qua Tech's WSB-10 is an arbitrary waveform generator for the IBM Personal Computer. Application software with BASIC-callable drivers is supplied with this system.

WSB-10 lets you define up to 2048 data points. The data points can be output as periodic, single-cycle, or burst waveforms in single-cycle or continuous modes. A 16-bit software-programmable timer is used to set the output rate from 2.4 millihertz to 5 MHz. Output resolution is 12 bits, with a range of −5 to +5 volts. The WSB-10 operates as a stand-alone unit after it has been initialized.



With software, the WSB-10 is $595. For more information, contact Qua Tech Inc., 478 East Exchange St., Akron, OH 44304, (216) 434-3154.

Circle **563** on inquiry card.

Graphics, Text Merged, Output on Daisy-Wheel

IBM PC, PC XT, and PC AT users can merge text and graphics and print the results on a letter-quality printer with ConvertaBuffer II and GT Merge software from von Leivendyke Enterprises.

ConvertaBuffer II, a plug-in card, lets you print presentation graphics on your daisy-wheel or thimble printer using its period character. It does this by translating the Epson graphics output from such programs as Lotus 1-2-3 into the necessary format for graphics printing on most letter-quality printers. ConvertaBuffer comes with a parallel printer adapter and 32K bytes of print buffering, expandable to 64K bytes.

GT Merge is a menu-driven program for intermingling graphics and text. It lets you position graphics anywhere on a page, as well as crop and rotate your image. Positive- or negative-image printing can be obtained, and full disk saves are supported. Additionally, GT Merge has a mail-merge facility that's compatible with dBASE and other database-management software. It's also compatible with a variety of word processors, graphics programs, and text editors.

ConvertaBuffer II with the GT Merge software is $249. Contact von Leivendyke Enterprises, Silvermine Ave., Norwalk, CT 06850, (203) 846-4973.

Circle **564** on inquiry card.

Low-Cost Light-Pen System

Tech-Sketch is a color-graphics, light-pen system for the Apple II, II+, and IIe, complete with interface card and software.

At the heart of Tech-Sketch is a program called Micro Illustrator. This program lets you store up to 48 pictures on disk, erase mistakes, and magnify images on a pixel-by-pixel basis. It provides 10 different brush strokes and such drawing modes as lines, rays, boxes, circles, color fill, and freehand drawing. Picture data can be stored in binary format for transmission or hard-copy output. Color shading is also offered.

The light pen features fingertip control and a coil-free cord. The interface card plugs into Apple slot 7 (slot 5 is also acceptable) and is cable-connected to a joystick port outside the computer. The light pen is hooked into the joystick port.

The complete Tech-Sketch package is $149.95. For further details, contact Tech-Sketch Inc., 26 Just Rd., Fairfield, NJ 07006.

Circle **565** on inquiry card.

Expansion Boards Extend PC Memory

The Persyst PC/Memory Plus Clock and the PC/Short Memory expansion boards from Emulex Corporation are tailored for the IBM PC, PC XT, PC AT, and the Portable PC.

The PC/Memory Plus Clock, a full-size multifunction board, can be equipped with up to 576K bytes of memory. It features a clock/calendar for automatic time/date stamping of your files and a program-security facility. It has split-memory addressing, which lets you use application programs that require more than 640K bytes of RAM by providing access to an additional 128K bytes of memory.

Two software programs, Insta-Drive and Wait-Less Printing, come with PC/Memory Plus Clock. Insta-Drive employs user-assignable RAM for disk emulation that's equivalent to four single-sided floppy-disk drives. Wait-Less Printing buffers up to 30 pages of data or text. Buffering is user-defined through automatic spooling for serial or parallel printers.

The PC/Short Memory board for the half-size PC XT or Portable PC expansion slot is designed to provide up to 384K bytes of memory. It's available in five configurations: 64K, 128K, 192K, 256K, and 384K bytes. Byte parity is provided, and switch-selectable starting addresses, ranging from 128K to 512K bytes, allow it to operate with a variety of motherboard RAM capacities.

The PC/Short Memory board can also plug into a full-size PC AT slot, enabling you to realize that computer's full 640K-byte memory capacity.

The price for the basic 64K-byte PC/Memory Plus Clock is $345. The top-of-the-line 576K-byte version costs $1145. With 64K bytes of memory, the PC/Short board is $259. The 384K-byte model sells for $759.

For complete specifications, contact Emulex Corp., 3545 Harbor Blvd., POB 6725, Costa Mesa, CA 92626, (800) 854-7112; in California, (714) 662-5600.

Circle **566** on inquiry card.

MASS STORAGE

Winchester Has 256K-Byte RAM Cache

The DisCache Winchester-disk subsystem for the IBM Personal Computer has an internal, microcomputer-controlled RAM cache area. The cache, which can be used for programs or data, has an access time of 100 microseconds (maximum). The average disk-access time is 8 milliseconds.

Available with 10, 20, or 40 megabytes of formatted storage and with a 256K-byte cache, the DisCache has an independent microprocessor that monitors and files frequently requested sectors in the RAM cache. Part of the cache is reserved for a so-called anticipatory buffer, which consists of 31 sectors related to the requested one.

When writing a sector to disk, the DisCache processor immediately stores the sector into RAM, which frees your program for further processing without a disk-access delay. The processor transfers each new sector to disk.

The processor constantly keeps track of the sectors being updated, and at the end of the day, it gives you the option of writing just those sectors to the computer's floppy disk.

Other features include shared access of 0.5 megabyte for up to 21 computers, support of multiple operating systems that can be selected from a front-panel display, a 1-megabyte print spooler, and a choice of ports: Centronics parallel or RS-232C serial.

DisCache will also work with NEC and Apple computers. A 10-megabyte DisCache lists for $3350. The 40-megabyte DisCache will list for $5650 when shipments begin in January. For more information, contact Eicon Research Inc., Penthouse Suite, 520 Fifth Ave., New York, NY 10036, (212) 719-5353.

Circle **567** on inquiry card.

NCR Hard Disks Are IBM-Compatible

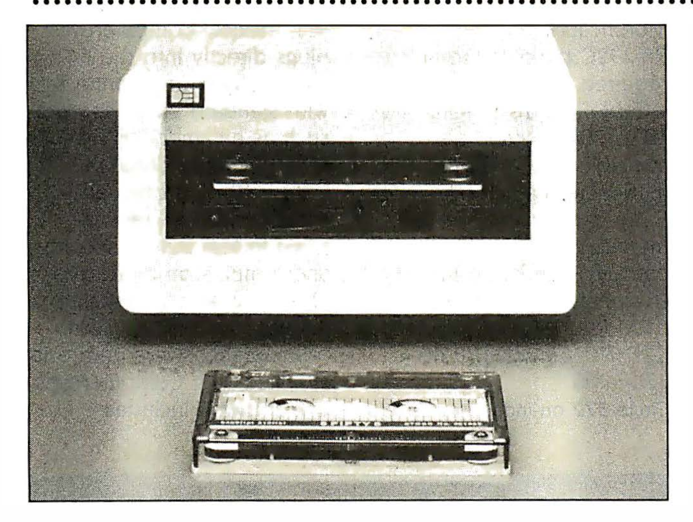
NCR's 6097 series of IBM PC-compatible hard-disk drives are available with storage capacities ranging from 10 to 60 megabytes. The series is divided into basic single- or dual-drive 10- and 30-megabyte units, all of which fit into the same enclosure. One full IBM expansion slot is required, and the series is compatible with the IBM hard-disk operating system, which lets you boot directly from the drive.

The 10- and dual 10-megabyte drives feature a recording density of 9075 bits per inch and an average disk-access time of 93 milliseconds. The 30- and dual 30-megabyte drives have 9550-bit-per-inch recording densities and a 53-millisecond average access time.

The 10-megabyte 6097 fixed-disk drive is $2750. Its double-drive complement is priced at $3750. The basic 30-megabyte unit sells for $4250. With twice the storage, it's $6750. For further details, contact NCR Corp., 3718 North Rock Rd., Wichita, KS 67226.

Circle **568** on inquiry card.

Tape Subsystem Works Like Floppy



Data Electronics has entered the end-user market with a tape-cartridge subsytem that serves both as a streaming-tape backup and as a large-capacity disk drive. The SL-6 subsystem, which is designed for the IBM PC XT, handles 17 megabytes of formatted data or 21.3 megabytes of unformatted information. It uses a high-density ¼-inch tape cartridge that meets all ANSI X3.55-1977 standards.

The SL-6 features file-selectable and intelligent streamer modes. The file-selectable mode lets you retrieve and work with files just as if you were using a floppy disk. In its intelligent streamer mode, the SL-6 bypasses unused space and bad sectors, which are normally copied by streaming-tape backups, and stores only your data files.

The SL-6 reads data at 30 ips and searches at 90 ips. At 30 ips, the transfer rate is 24K bytes per second. The head type is dual gap read/write, with a four-track serpentine with separate erase. To support the strain inherent in the file-select feature, the SL-6 is said to incorporate a special-purpose start/stop motor.

The SL-6 is $2195. The media are $46. Contact Data Electronics Inc., 10150 Sorrento Valley Rd., San Diego, CA 92121-1699, (619) 452-7840.

Circle **570** on inquiry card.

Disk Subsystem Stores 20 Megabytes

Plato, a 20-megabyte Winchester hard-disk subsystem for the Apple II, comes with a controller and a host adapter with software enhancements in ROM.

This subsystem supports and runs four operating systems: AppleDOS, ProDOS, Pascal, and CP/M. DOSes can be switched with a simple command, and all are auto-bootable. Utility software on the host adapter includes file, volume, or disk copy. Individual files and volumes can be password-protected.

Single-unit pricing for Plato is $1500. Contact Disc Tech One Inc., 849 Ward Dr., Santa Barbara, CA 93111, (805) 964-3535.

Circle **569** on inquiry card.

(continued)

PERIPHERALS

IBM Unveils Printers

IBM's Quietwriter and Wheelprinter printers are compatible with the full PC product line, including the PCjr and the Portable PC.

The Quietwriter operates at 40 cps in 10 pitch, 48 cps in 12 pitch, 60 cps in 15 pitch, and 40 to 60 cps in proportional spacing. Double-width printing is available with all pitches. It uses electronic type-font cartridges, two of which are on line simultaneously, and supports graphics output.

Automatic cut-sheet and continuous-forms feed paper-handling capabilities are optional features; semi-automatic cut-sheet feed is standard. Supplied diagnostics are power-on test and operator-initiated ripple and wrap.

Quietwriter comes with four 252-character electronic fonts, print ribbon, print head, cleaning cartridge, and a Centronics-type parallel interface. It lists for $1395.

The bidirectional Wheelwriter uses a 96-character cartridge print wheel. Print pitches are 10, 12, and 15, plus proportional spacing. It offers 25-cps burst printing at 12 pitch. Integrated continuous-forms and automatic sheet feed capabilities are standard.

It comes with nine ASCII print wheels and single- and multistrike ribbons. Either Centronics parallel or RS-232C serial interfaces are available. The list price is $1795. For more information, contact IBM Corp., POB 1328, Boca Raton, FL 33432, (800) 447-4700.

Circle **571** on inquiry card.

Optical-Link RS-232C Modem Set

The FI-DP232 from Foundation Instruments is a fiber-optic RS-232C modem set offering fully passive operation and full RS-232C functionality. The link is made up of twin modems, mounted at both ends of a length of cable. The modems plug into a standard 25-pin RS-232C source, such as a printer or computer, in a matter of seconds.

The FI-DP232 derives its operating power from the transmit data. It supports full-duplex asynchronous operation from 75 to 20,000 bps. DTC or DCE operation is switch-selectable. Modifications to the RS-232C pin-outs are not required.

Cable lengths ranging from 10 to 2000 meters are available. The FI-DP232 with a 10-meter cable costs $495. Extra cabling is $2.98 per meter. For further details, contact Foundation Instruments Inc., 24 Colonnade Rd., Nepean, Ontario K2E 7J6, Canada, (613) 226-4000.

Circle **572** on inquiry card.

Capture Images for Commodore

Computereyes is a video-acquisition system for the Commodore 64. A slow-scan device, Computereyes plugs directly into the 64's user I/O port and connects with standard video sources, such as a camera or videodisc unit. Through software control, a black-and-white image can be captured in less than 6 seconds, and a multiscan mode provides you with gray-scale images.

Comprehensive software is supplied with Computereyes. The software includes machine-language image-capture routines, a menu-driven executive, and image compression/decompression routines to maximize disk space.

A Commodore 1541 or compatible disk drive is required. With interface module, software, and manual, Computereyes is $129.95. A complete system with a camera can be purchased for $349.95. Contact Digital Vision Inc., Suite 2, 14 Oak St., Needham, MA 02192, (617) 444-9040.

Circle **573** on inquiry card.

NEW SYSTEMS

MicroMix Expands DP Operations

The MicroMix 16 from Trios Micro Systems is a 16-bit computer said to be completely compatible with IBM PC and PC XT hardware, peripherals, and software. It is designed to use the IBM's keyboard and display screen for PC and host operations. The MicroMix 16 plugs directly into the IBM computer or into an asynchronous terminal, permitting full use of a data-processing department's base of installed terminals. It can connect with IBM 3270-type computers, ASCII terminals with RS-232C ports, electronic typewriters, stand-alone word processors, and other personal computers.

The basic system comprises a 16-bit Intel 8088 processor, 128K bytes of RAM, a 320K-byte double-density drive, and a universal terminal controller (UTC), which is a high-speed interpreter and communications controller between the MicroMix 16's central processor and the attached computer.

MicroMix 16 accepts accessory boards and peripherals built for the IBM PC and offers room for a second disk drive and a mathematics coprocessor. It has a single RS-232 serial port, four I/O expansion slots, and a Centronics-type parallel printer port. RAM is expandable to 256K or, with IBM PC memory expansion cards, to 640K bytes.

Optional equipment includes 64K-byte memory upgrades, a secure transfer program, a keyboard, and a carrying case.

A basic unit, with 256K bytes of RAM, twin floppy-disk drives, serial and Centronics ports, and an asynchronous terminal controller, sells for $2150. With one drive, a 10-megabyte Winchester hard disk, parallel and serial ports, and the UTC with IBM 3278 coax and RS-232C interface, the MicroMix 16 sells for $3586. For further information, contact Trios Micro Systems Inc., 147 Beacon St., South San Francisco, CA 94080, (415) 583-7733.

Circle **574** on inquiry card.

NEW SYSTEMS

MS-DOS, Proprietary DOS, Multiusers

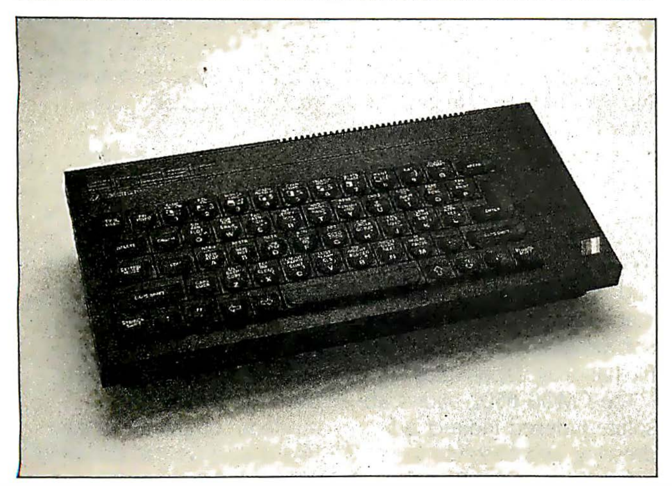
The AM-680 Series ELS from Alpha Microsystems is a multiuser computer with two operating systems and a pair of microprocessors. Capable of supporting three users, ELS combines a 16-bit Intel 8088 running MS-DOS and the 16-/32-bit Motorola M68000 chip running AMOS, a proprietary multiuser operating system.

Standard equipment on the AM-680 includes a 10-megabyte hard-disk drive, a single 360K-byte floppy-disk drive, an M68000 coprocessor board, a monitor with controller, a keyboard, and a battery-backed clock/calendar for AMOS. It has 128K bytes of RAM, expandable to 256K, dedicated to AMOS and 256K bytes of memory for MS-DOS, which can be expanded to 640K bytes. Single serial and parallel interface ports are supplied.

The AM-680 has been designed with a number of performance features that facilitate the integration of both DOSes. For example, the 10-megabyte hard disk can be partitioned between the operating systems, which maximizes disk space. Another feature lets you transfer text files between the operating systems.

Options include a color monitor, an IBM serial interface, and 128K-byte expansion boards. With a monochrome monitor, the AM-680 Series ELS is $6870. With a color monitor, it's $470 more. Contact Alpha Microsystems, 17332 Von Karman Ave., Irvine, CA 92714, (714) 957-8500.
Circle 575 on inquiry card.

Sinclair Adds Full-Travel Keyboard to Spectrum



Sinclair Research has announced that the ZX Spectrum's original "chiclet" style keyboard has been abandoned in favor of the full-travel keyboard used on the company's QL computer.

The ZX Spectrum+ is a Z80A-based microcomputer with 48K bytes of RAM and 256- by 176-pixel graphics in eight colors. In England, it costs £179.95 (approximately $213). It is not available in the U.S..

Contact Sinclair Research Ltd., 6 Kings Parade, Cambridge CB2 1SN, England: tel: 011 (44) 233-353-204.
Circle 576 on inquiry card.

SOFTWARE • APPLE

Program Computes Deviation, Draws Graphs

A graphics software package for scientists and engineers, Analytical Graphics runs on the Apple II+ and IIe. It accepts data from the keyboard or DIF files, computes the standard deviation or standard error of the mean, and displays the data and error bars in a variety of graphic formats.

With Analytical Graphics, you can produce point and line graphs and solid, line, split, or merged bar charts. Linear, semilog, and log/log axes can be used with automatic or manual scaling. Multiple line or bar overlays and linear regression analyses are supported. Labels and headings are user-controlled. Hard copy can be obtained through screen dumps.

Analytical Graphics requires 64K bytes of RAM and a disk drive. It's priced at $90, which includes two copies of the program, a tutorial disk, and a manual. Contact Scientific Software Products, 5726 Professional Circle, Indianapolis, IN 46241, (317) 244-6163.
Circle 577 on inquiry card.

Turn Mac into an Information Center

MacLink converts the Macintosh into an information utility system that can serve as a private electronic-mail system, a public news system, a file-distribution system, or all three. It uses a simple user interface and supports remote access from Macintosh computers, personal computers, and ASCII terminals.

MacLink handles 7 or 8 data bits with even, odd, or no parity and a single stop bit. Automatic data-rate select is provided, with rates of either 300 or 1200 bps.

The electronic-mail capability has such features as address validation, reply generation, and mail-receipt verification. Its editor is said to be easy to use, and MacLink imposes no limit on message size.

The BBS aspect of MacLink permits a virtually unlimited number of categories to be read or posted. Features such as headline scanning, automatic reply generation while reading, and reading specified articles without pause are standard. Users can specify the range of articles to be read, or MacLink can automatically give them a list of newly posted items.

Data files can be uploaded and downloaded with the file system. With MacLink, you can create any number of directories for categorizing files. A summary list is available, and a file list showing names, sizes, date and time of upload, and a description of a file's contents is provided.

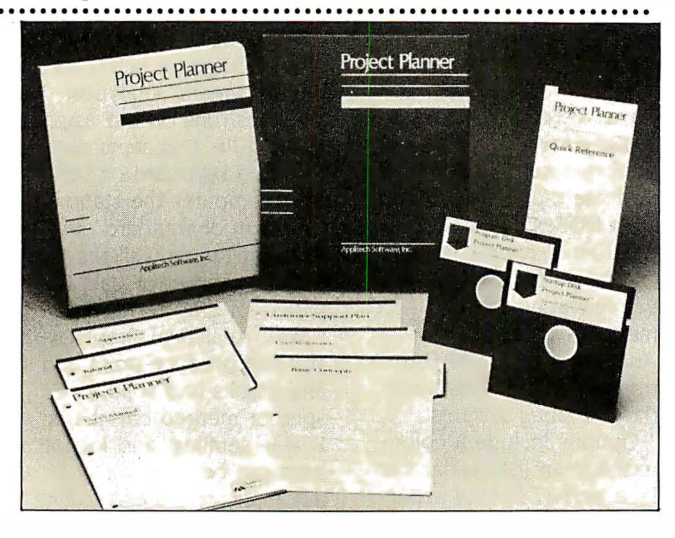
Sysops access MacLink from the Macintosh or from a remote site. They wield commands that let them enter the message of the day, change a user's access privileges, delete users and items, add and change categories or file system directories, and shut down the system.

MacLink's suggested price is $50. For more information, contact Connick and Associates Inc., 2329 Old Trail Rd., Reston, VA 22091. For an on-line demonstration, call (703) 476-9459.
Circle 578 on inquiry card.

(continued)

SOFTWARE • APPLE

Idea Processor/Project Manager Lets You Visualize Plans



Applitech Software's Project Planner is an idea-processor/project-management tool for the Apple II family that lets you analyze the planning and scheduling of a project still in its formative stages.

The key to this system, according to the manufacturer, is its automatic project graph-filtering and generation capability. This feature lets you enter activities and a minimal amount of information into Project Planner, which then automatically generates a project flowchart and schedule and filters out inconsistent information. Once the flowchart is prepared, you can use the supplied critical-path method (CPM) feature to fine-tune your project.

Project Planner has traditional CPM capabilities. It lets you plan, organize, schedule, and monitor a project, focus on its critical activities, and see and analyze the results of alternative strategies.

Currently available for dual-drive, 64K-byte Apple II+, IIe, and IIc computers, Project Planner has a suggested retail price of $150. An enhanced, 128K-byte version for the Apple IIc and IIe with 80-column card will be available soon. An IBM PC version with a user interface similar to the Macintosh is in the works. Contact Applitech Software Inc., 381 Harvard St., Cambridge, MA 02138, (617) 497-8268.
Circle 579 on inquiry card.

Search, Edit Mac's Memory

Mac Zap, a Macintosh disk and memory utility program, lets you search, edit, and modify a disk or memory. It supports a full-screen editor using the Mac's mouse and hexadecimal and ASCII formats. If you have two disk drives, you can compare and copy disks.

Mac Zap provides disk information regarding block allocation maps and volume information (edit). File information provided includes a file allocation map for resource and data forks and edit file information.

After you create, say, a block allocation map, you can use the Mac Zap utilities to apply patches or recover files. Mac Zap is suitable for repairing damaged disks and customizing menus. It has a routine that lets you search a disk for damaged areas or the Mac's memory.

The suggested list price is $60. Contact Micro Analyst Inc., POB 15003, Austin, TX 78761, (512) 926-4527.
Circle 580 on inquiry card.

New Apple DOS

DOS 4.0 from Rune Enterprises is said to provide up to 35 percent more disk-storage space than prior Apple disk operating systems. DOS 4.0, which comprises a CMOS 6502 microprocessor, software, and supporting manuals, has a suggested retail price of $95.

DOS 4.0 increases the available RAM for language-card users by 10K bytes and can expand the formatted disk-storage capacity to approximately 190K bytes. It reportedly has faster reading and updating of files, automatic compression of Applesoft programs, and improved file-handling capabilities.

The CMOS 6502 allows absolute indexed indirect addressing and absolute indirect addressing. Branch always and store zero in memory are two of its eight new instructions.

DOS 4.0 works with the Apple II, II+, and IIe. Contact Rune Enterprises, Sales Department, Suite 214, 80 Eureka Square, Pacifica, CA 94044, (415) 355-4851.
Circle 581 on inquiry card.

Site Network on Apple

Nocterminal is a telecommunications program that lets you use an Apple IIc, IIe, or III as the intelligence behind a network.

It's a simple system designed for showing, selling, or receiving orders. Attendants are not required, and Nocterminal uses standard communications protocols. Presently, it operates at full-duplex with 7 bits and space parity.

Nocterminal lets you enter data, customize files, impose time limits, and test presentations before they go on line. The entire system can be password-protected. As operator, you can access selected password-protected files and allow callers to attach comments to files.

Nocterminal comes with a text editor, a filing utility, and operator and caller assistance. Both help systems contain text files that can be edited by the system operator. An on-line mode lets you display information to callers automatically.

The Apple III version of Nocterminal, $200, requires 256K bytes of RAM. It runs in native mode. The IIc/IIe versions, $175, need half as much RAM. Additional hardware requirements are an auto-answer modem that supports the Hayes Smartmodem command set and two disk drives. If you wish to use Nocterminal's connect-log, time-out, and time-stamp file features, a system clock is needed.

Contact Nocturnal Software, POB 794, Soquel, CA 95073, (408) 462-3912. For an on-line demonstration, call (800) 237-0601; in California, (800) 523-7917.
Circle 582 on inquiry card.

SOFTWARE • APPLE

Run DOS 3.3 Programs on Profile

Profix lets you run your DOS 3.3-specific software on the Apple ProFile hard disk without converting to ProDOS. You can map portions of the ProFile with DOS 3.3 format and reserve other areas for ProDOS and Pascal.

The Profix utilities disk comes with file-transfer programs, a configuration program, and routines for initialization, disk copying, and disk backup. It runs on the 64K-byte Apple II+ and 64K- or 128K-byte Apple IIe systems. It costs $59.95. Contact Nordic Software Inc., 4910 Dudley St., Lincoln, NE 68504, (402) 466-6502.
Circle 583 on inquiry card.

Easy to Design Graphs

Gemini Video says that its Environmental Graphics software is tailored for people who want easily designed graphs. It includes contour maps, scatter diagrams, linear and logarithmic axes, bar and pie charts, and mathematical equations. Graph and text editing is provided, and data is entered in a style that's similar to a spreadsheet.

Environmental Graphics runs under DOS 3.3 on the Apple II. This program sells for $69.95. For more information, contact Gemini Video, POB 2018, Vernon, CT 06066, (203) 875-0052.
Circle 584 on inquiry card.

SOFTWARE • CP/M/MS-DOS

68000 Assembly Development Package Works with CP/M

XMAC68K is an assembly-language development package for computers based on the Motorola 68000 microprocessor and running under CP/M, CP/M-86, MS-DOS, or PC-DOS.

Priced at $595, XMAC68K will also be available for several different implementations of UNIX.

The XMAC68K package is composed of assembler, macro preprocessor, linkage editor, librarian, and symbol report generator modules, augmented by utility programs. It uses standard 68000 assembly-language code as input, and its various modules work in consort to produce hexadecimal object files in Intel, Mostek, and Motorola formats.

According to the manufacturer, key features include compatibility with Motorola assembly language, macro instructions and structured assembly statements, detailed cross-references, and English diagnostic messages.

For further details, contact Avocet Systems Inc., 10 Summer St., Rockport, ME 04856, (207) 236-8227.
Circle 585 on inquiry card.

BASIC Compiler Has Multitasking Abilities

A process-control BASIC compiler featuring high-speed executions and real-time, multitasking capabilities, CDI*BASIC is designed for computer-control projects for any CP/M-based system. In addition to most standard BASIC commands, this compiler has a number of commands that facilitate interfacing with the Z80 interrupt structure.

Because only one task can be in control of the processor at any given time, CDI*BASIC cannot be considered a true multitasking system. However, the software within it automatically switches processor time between each task, which, in turn, results in the appearance that multiple tasks are running concurrently.

Source code is compiled at a rate of more than 100 BASIC lines per second and then executed. Compiled Z80 code can be stored to run at a later time without a run-time license agreement.

CDI*BASIC can provide machine-language programmers with a list of jump vectors of all designated logical I/O devices, which can be helpful when writing high-speed, custom I/O drivers.

With a manual, this package has a suggested list price of $485. Most CP/M formats are available. A demonstration disk with the manual can be obtained for $30. Contact Computer Dynamics, 105 South Main St., Greer, SC 29651, (803) 877-7471.
Circle 586 on inquiry card.

CP/M Communications Utility

A CP/M-based communications package, the Softcom-Telecommunications Utility can be used as an intelligent terminal program and as a CP/M-to-CP/M file-transfer tool. Softcom can be used to turn your computer into a terminal to host a timesharing system or for capturing data from a host. When communicating with another microcomputer running Softcom, you can exchange files with error detection and automatic retry.

In its intelligent terminal mode, Softcom supports half-duplex and full-duplex transfer at rates of up to 9600 bits per second. Since it supports XON/XOFF protocols, Softcom can be used for sending large ASCII files to any host using those protocols. Unattended file transfers between CP/M systems and transfers through the CP/M console port are also supported.

Data can be prepared beforehand or at the terminal at the time of transfer. Received data can be stored or printed.

The Softcom-Telecommunications Utility package requires 32K bytes of memory, the CP/M operating system, and a computer based on an 8080, 8085, or a Z80 microprocessor. Softcom is available in most 8- and 5¼-inch disk formats. The list price is $150.

For more information, contact The Software Store, 706 Chippewa Square, Marquette, MI 49885, (906) 228-7622.
Circle 587 on inquiry card.

(continued)

SOFTWARE • CP/M/MS-DOS

Dynamic Debuggers

Pfix86 and Pfix86 Plus are advanced debugger utility programs for 8088/8086 microcomputers with MS-DOS.

Pfix86 is a dynamic debugger for use with assembly language or high-level programming languages. Its multiple-window display lets you simultaneously view program code and data, breakpoint settings, current machine register, and stack contents. An in-line assembler and such advanced breakpoint features as permanent and temporary settings are provided. Pfix86 supports single-keystroke tracing.

Pfix86 Plus is an enhanced version of Pfix86 that offers symbolic and overlayed program debugging capabilities. The symbolic debugging tool eliminates hassling with linker memory maps because it accepts symbolic names whenever you would normally have to enter an address. Its in-line assembler permits temporary patches, which prevents the need to recompile when program bugs are identified.

Pfix86 is priced at $195, and Pfix86 Plus is $395. Contact Phoenix Computer Products Corp., Suite 220, 1416 Providence Highway, Norwood, MA 02062, (617) 762-5030.

Circle 588 on inquiry card.

SOFTWARE • IBM PC

Word Processor for Scientists

The T³ Scientific Word Processing System from Triad Computing provides for unlimited file size, 25 levels of superscripts and subscripts, chemical formulas, complex mathematical expressions, footnotes, headers, and footers. This is a menu-driven system that runs on the IBM PC, PC XT, PC AT, and many compatibles.

T³ lets you define and mix eight fonts in a single document; each font contains 128 characters. It has standard word-processing functions, such as move, copy, and delete, as well as a font editor, and boldface, underline, and strike-out of any character. Various dot-matrix and laser printers, such as Epson and IBM, are supported; drivers are available for other printers.

Two double-sided, double-density disk drives, PC-DOS, 512K bytes of RAM, and a color-graphics adapter are required. It can run off a hard disk. T³ is $595. A UCSD Pascal version is $495.
For details, contact Triad Computing Inc., 1190-B Foster Rd., Las Cruces, NM 88001, (800) 874-2383; in New Mexico, (505) 522-4600.

Circle 589 on inquiry card.

Compiler Enhances dBASE III Applications

Clipper is a compiler for Ashton-Tate's dBASE III relational database system. The manufacturer, Nantucket Inc., says that compiled dBASE III applications should run from 2 to 20 times faster than interpretive versions. Clipper is also said to make more efficient use of disk-storage space by creating more compact application-code files than interpreted versions of dBASE III.

This compiler generates relocatable, executable elements that cannot be backtracked to the source codes. Consequently, you are not forced to devise complex data-encryption schemes to guard your work. Clipper has a complete set of compiler-generated error messages that assist in locating programming bugs.

Clipper is currently available for the IBM PC and true compatibles. Versions for major 8- and 16-bit computers will be announced soon. The suggested list price is $695. Contact Nantucket Inc., 20456 Pacific Coast Highway, Malibu, CA 90265, (213) 456-7315.

Circle 590 on inquiry card.

Four-In-One Color Graphics System

ProDraw for 256K-byte IBM PCs combines a color paint system, database with an auto-cycle option, a NAPLPS non-SRM decoder, and a telecommunications emulator. It provides the means for creating and transmitting color graphics and text images for a variety of presentations.

The drawing module uses pop-up menus and gives you rubber-banding and graphics- and text-editing abilities. Also featured are scrolling within windows and an on-line manual.

The database allows for an unlimited number of pages to be linked into a presentation. Each page can branch into 10 different pages. As many as 200 ProDraw images can be stored in a single 360K-byte floppy disk.

ProDraw's decoder module produces displays with a 320- by 200-pixel resolution in 10 or 16 colors, dependent upon your color board. It has eight fill textures and user-definable brush and text sizes.

The terminal emulator has ASCII and NAPLPS modes, auto-dial and log-on, file-save capabilities, and 300- to 9600-bps data rates. Five different color boards are supported.

ProDraw works with more than 20 IBM PC-compatibles. DOS 2.0 is required. The price is $350. Contact Limicon Inc., 144 Hampton Ave., Toronto, Ontario M4K 2Z1, Canada, (416) 481-7859.

Circle 591 on inquiry card.

Multitasking for IBM

Multi-Job lets you run up to nine IBM PC-DOS programs simultaneously. The keyboard and screen can be assigned to any job with a simple keystroke, while the remaining jobs execute unattended.

Multi-Job divides computing time and memory among tasks. It lets you assign job priorities, and any task can be displayed.

Additional hardware is not required; however, extra system memory may be required by your programs. It supports DOS 2.0, 2.1, and 3.0 running on the IBM PC, PC XT, and PC AT. It costs $159. Contact B&L Computer Consultants, Suite B, 7337 Northview, Boise, ID 83704, (208) 377-8088.

Circle 592 on inquiry card.

SOFTWARE • IBM PC

Indexing Tool for Word Processors

Texin is a general text-indexing tool that creates an index for standard text files. Phrases, sentences, or paragraphs also can be extracted and saved for later reference, and indexes can be printed in a standard format or with page and line numbers.

Texin lets you devise keyword files from the original text or from your own list. Both keyword and index files can be updated or modified at any time, and when you add or delete pages from your manuscript, Texin lets you update the index file without creating a new one.

The original text is not corrupted when you use Texin. In addition, keyword extraction and index creation do not demand that you manually scan the text to identify keywords.

A conversion module lets you alter WordStar files for direct processing. This feature can be used to create a standard ASCII file for transmission or printing outside of WordStar. Miscellaneous features include menu-driven operation, extensive help, error messages, on-line explanations, and word tallies by keywords, references, or total manuscript word count.

An IBM PC or PC-compatible with 128K bytes of RAM, PC-DOS or MS-DOS, and one disk drive is required. It sells for $80. Contact Mariach Ltd., POB 1324, Station B, Ottawa, Ontario K1P 5A0 Canada, (613) 237-3189.

Circle 593 on inquiry card.

Solve Equations

Optisolve is a mathematical problem-solving program for the IBM PC and selected MS-DOS microcomputers. It can handle such problems as least-squares fitting, single equation with one unknown, a system of simultaneous equations in several variables, and maximization or minimization of a function with constraints. Transcendental functions include exponentials, logarithms, and trigonometric functions. Solution accuracy is seven digits.

Optisolve lets you enter problems in symbolic form, without requiring the use of a programming language. You can also enter problems from a file.

This program accepts linear or nonlinear constraints in the form of equations or inequalities. You can modify variables interactively, and variables can be real or complex. Variable names can have an arbitrary length. Optisolve can give you global solutions or local solutions that are near to the input starting values.

If you have Lattice C or Microsoft's C Compiler, you can link Optisolve with C language functions. Minimum hardware requirements are 128K bytes of RAM and a disk drive. DOS 1.0 or higher is necessary. An 8087 coprocessor is recommended. A Macintosh version will be available soon. The list price is $195. For more information, contact Optisoft, 1445 Crone Ave., Anaheim, CA 92802.

Circle 594 on inquiry card.

SOFTWARE • OTHER COMPUTERS

PDP/11 Compatibility for Pro 350

S&H Computer Systems' Pro/TSX-Plus operating system transforms the DEC Professional 350 into a multiuser, PDP/11-compatible computer.

Pro/TSX-Plus gives the Pro 350 three-user capability, multitasking operation, and access to the entire range of applications and utilities under DEC's RT-11 operating system.

At the heart of Pro/TSX-Plus is an adaptive scheduling algorithm that enhances resource management for rapid system response. It lets you set your job priorities, and it then adjusts those priorities for the best response during the program execution. Other enhancements to increase system response include data and directory caching for improved file I/O speed.

Pro/TSX-Plus gives you 64K bytes of virtual address space for each task, which lets you run the full complement of RT-11 applications. Unreserved physical memory can be used by programs that employ either virtual overlays or arrays.

Miscellaneous features are spooled printing, record locking, communications with dial-in support, concurrent program control, log-on security, interprogram messages, and a virtual debugger.

Pro/TSX-Plus is $900. Quantity discounts are offered. Contact S&H Computer Systems Inc., 1027 17th Ave. S, Nashville, TN 37212, (615) 327-3670.

Circle 595 on inquiry card.

Low-Cost Communications for TRS

LazyComm is a $34.95 communications program for the Radio Shack TRS-80 Models I, III, and 4. It can be configured for any host system, and LazyComm automatically logs on and dials using a smart modem. It also tracks your time on line.

Many LazyComm parameters, such as the codes for XON and XOFF, are user-definable. All framing, parity, and overrun errors are reported by means of graphic shapes on screen.

You can send received data to a printer for continuous output or store it to disk. Print screens are supported. When you're uploading data, LazyComm gives you the option of sending blocks or single lines of text. Information can be sent or received at rates of up to 9600 bps. Also featured are ASCII and binary file transfers and a capture buffer with room for approximately 30K bytes of data.

LazyComm works with any Model I or III DOS. It can be integrated with the Lazy Writer word processor in the Model I, III, or 4 versions. Contact AlphaBit Communications Inc., 13349 Michigan Ave., Dearborn, MI 48126, (313) 581-2896.

Circle 596 on inquiry card.

(continued)

SOFTWARE • OTHER COMPUTERS

Open Access for DG/One

Open Access, an integrated software package, is available for the Data General/One portable computer.

Open Access is made up of six modules: relational database, spreadsheet, word processing, appointment calendar, communications, and graphics. It comes on five 3½-inch floppy disks, which include a pair of tutorials.

The database can process five files simultaneously. The spreadsheet is not limited to RAM space, and the word processor can link files together and incorporate data and graphics from other modules.

The graphics module, which has three-dimensional capabilities, can be used for creating slide shows. The communications module can be set to operate in either slave or unattended modes.

Open Access is $695. It's also available for the Compaq, Columbia, IBM PC, Sperry, Tandy 2000, TI Professional, and IBM PC-compatibles. Contact Software Products International, 10240 Sorrento Valley Rd., San Diego, CA 92121, (619) 450-1526.

Circle 597 on inquiry card.

Software Streamlines Office

The Administrator is an office-automation software system for the DEC Rainbow. An integrated package, the Administrator can operate alone or as part of a linked network. It's designed to streamline such office tasks as scheduling meetings, tracking memos, and outlining personal expenses. When used in a network, the Administrator automatically checks for conflicts in the schedules of all individuals on the system.

The Administrator provides a clock/scheduler system, a personal to-do list, an index file, a calculator, an expense tracker, electronic mail and filing, and a telephone message file.

A Rainbow with 256K bytes of memory, a disk drive, and a 5-megabyte hard disk is required. The Administrator will also work with the DEC Pro 350 series and the IBM PC XT and PC AT. The suggested retail price is $795. A license for the multiuser DEC Pro 350 is $1795. For more information, contact Inteck Inc., Suite 20, 695 South Colorado Blvd., Denver, CO 80222, (303) 733-5900.

Circle 598 on inquiry card.

ALLWRITE!

ALLWRITE! from Prosoft is an advanced word processor for the Radio Shack TRS-80 Models I, III, 4, and 4P. It's suitable for writing simple letters, devising customized form letters, constructing legal documents, and authoring books. ALLWRITE! comes with controls for a variety of printers, and right-justified, proportional spacing is standard.

Two-key English-language-based commands simplify usage. Predefined soft keys for such functions as paragraph indents and centering text are also provided. ALLWRITE! can develop tables of contents, indexes, and footnotes. It can process several floppy disks as a single document.

An on-line help library explains more than 50 subjects and is accessed with a single keystroke. A quick-reference card fits on the keyboard, and a 350-page manual offers examples and a tutorial.

ALLWRITE! will work with the Electric Webster 1.7 spelling checker and the DotWriter 4.0 graphics text formatter. It will not work with CP/M.

ALLWRITE! file structures are upward-compatible with NEWSCRIPT's file structure. The Model 4 version supports an 80-column by 24-line screen and lets you edit three files simultaneously on a 128K-byte machine.

System requirements are 48K bytes of memory, two disk drives, and a TRSDOS-style operating system. ALLWRITE! is available for $249.95 from Prosoft, POB 560, North Hollywood, CA 91603, (818) 764-3131.

Circle 599 on inquiry card.

Music for the Commodore

Macmusic is a musical composition program for the Commodore 64 that has a user interface styled after the Apple Macintosh's, replete with pull-down menus and icons.

Melodies are drawn in color on screen using a joystick or a KoalaPad. They can be edited with such commands as select, invert, transpose, zoom, and cut/paste/copy. All editing functions have a direct correspondence with what's seen on screen and what's played back.

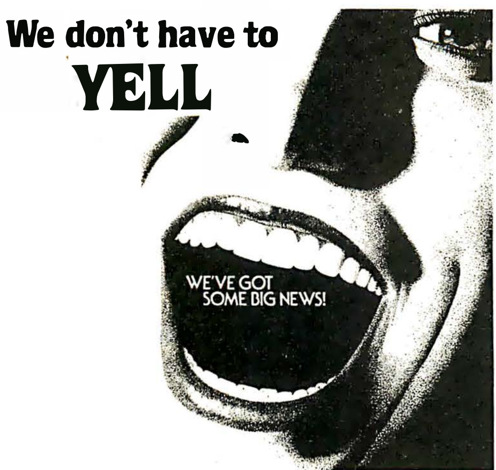
An arrange menu shows you how to change the order of a melody, which can then be saved to disk. An instruments menu lets you alter preset instruments during a preprogrammed tune, of which 10 accompany Macmusic, or while you are drawing a melody on screen.

Macmusic is a stand-alone package, although it will work with the Music 64 Keyboard. It's $49.95. Contact Passport Musicsoftware, Suite 103, 625 Miramontes St., Half Moon Bay, CA 94019, (415) 726-0280.

Circle 600 on inquiry card.

WHERE DO NEW PRODUCT ITEMS COME FROM?
The new products listed in this section of BYTE are culled from the thousands of press releases, letters, and telephone calls we receive each month from manufacturers, distributors, designers, and readers. The basic criteria for selection for publication are: (a) does a product match our readers' interests? and (b) is it new or is it simply a reintroduction of an old item? Because of the volume of submissions we must sort through every month, the items we publish are based on vendors' statements and are not individually verified. If you want your product to be considered for publication (at no charge), send full information about it, including its price and an address and telephone number where a reader can get further information, to New Products Editor, BYTE, POB 372, Hancock, NH 03449.

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- **training the most knowledgeable sales personnel**
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300W	$ 375
CA #P2 6-Plug Monitor Base	$ 99
C Itoh F-10-40 daisywheel	$ 945
F-10-55 55cps daisy	$1245
Corona Laser Printer (8 sheets/min)	$3250
Dataproducts Prism 132C (200cps, color, dual mode)	$1325
•8070 (400cps, tri-mode)	$1885
Epson FX-80	$ 395
FX-100 wide	$ 615
LQ1500 w/int	$1275
Hayes 1200 Smartmodem	$ 485
H-P Laserjet Printer	$2895
H-P Think jet Printer	$ 445
•Maxell 25 Disk Hamper w/key	$ 19
NEC PC8027 (PC8023 w/handle) printer	$ 365
P2 Pinwriter w/int	$ 675
P3 " w/int (wide)	$ 875
Okidata 92P-I	$ 425
93P-I	$ 625
PlotterS/Digitizers Houston Instrument	$-15%
Printronix P-300 w/Cen	$5100
P-600 w/Cen	$7100
Prometheus Promodem 1200	$ 355
Options Processor	$ 75
Q-4 "A-B" switch Serial	$ 65
"A-B" switch Parallel	$ 85
Star Micronics printers	
Gemini 10-X matrix	$ 275
Gemini 15-X wide	$ 385
PowerType **daisy,** w/ ser and par.	$ 355
Tractor	$ 55
TAXAN #305 TV TUNER	$ 95

PC SOFTWARE

Crosstalk XVI	$135
Remote	$125
•Transporter	$195
•dBase III	$425
dBase II - III kit	$145
•DC-10: Flight Simulator (PC or Sanyo)	$ 49
Fancy Font	$155
•Fontrix	$110
Framework	$425
Framework Programmers' Reference	$ 23
Harvard Project Manager	$285
Kensington Remote Control	$155
Knowledgeman	$355
Lotus 1-2-3	$310
Lotus Symphony	$455
Lotus 1-2-3 to Symphony	$155
Microsoft Fortran	$245
Microsoft Multiplan	$145
Microsoft WORD w/Mouse	$275
•Morgan Trace-86	$ 97
Norton Utilities 2.01	$ 59
Prokey 3.0	$ 95
Quaid Copy Write	$ 50
Quaid Disk Explorer	$ 75
•Quaid Zero Disk	$ 75
R:Base 4000	$295
Clout	$145
TK! Solver	$285
Tutor Disk (DOS)	$ 25
Vertex XenoCopy Plus 2.0	$135
XenoDisk	$365
•80Mate (Z-80 emulator)	$135
Warner Desk Organizer	$195
WordStar Pro (newest)	$345
•Zyindex Std (1500 documents)	$125

PC PERIPHERALS

Amdek 310A amber CRT	$ 169
710 RGB color	$ 565
AST PC-Net II Starter Kit	$ 795
AST SixPAK +, 64K	$ 265
Co-Processor 8087 Std	$ 165
• DTC 5150BX hard disk controller	$ 320
Everex Graphics Edge	$ 395
10MB Internal Hard Disk System	$ 845
FT 15+5 External	$2750
FT 33+5 External	$3475
5MB Cartridge	$ 95
Genie 5+5	$2650
• Genie 11+11	$3085
11MB Cartridge	$ 145
Hayes 1200B w/Smartcom	$ 435
Hercules Graphics Card	$ 335
I-2 10MB tape	$ 835
Tapes	$ 49
IBM Keyboard	$ 95
IOMega PC-20 dual removable	$2875
10 MB cartridge	$ 68
IRMA	$ 895
Keytronic KB5151	$ 195
Mouse w/Pop-up and Paint	$ 145
Orchid **PC Turbo-186**	$ 995
Blossom 64 w/PCNet	$ 575
Paradise Modular Graphics Bd	$ 295
"A" Module (P) (S) or (G)	$ 90
"B" Module (256K-64/C) (384K-64) or (Floppy/P)	$ 235
PC Replacement 100W Power	$ 175
PerSyst BoB w/Taxan #440	$ 975
PGS HX-12	$ 465
SR-12 w/Scan Doubler	$ 795
MAX-12 amber	$ 180
Phone Activated Power Module	$ 175
Prometheus Promodem 1200B w/soft	$ 285
RAM 64K (9 chips)	$ 41
RAM 256K (9 chips)	$ 325
• Sakata 13" RGB w/Optech Anti-Glare	$ 485
Shipping Case	$ 350
STB Graphix Plus II	$ 355
Tandon 100-2 dsdd	$ 175
TEAC 558 drive w/instructions	$ 137
Tecmar Graphics Master	$ 475
5 MB Removable Disk	$1475
3COM Etherlink	$ 595
• Vertex Apple Turnover	$ 265
Voicemail Dial/Log	$ 465

EPSON PX-8 GENEVA

This is an extraordinary value in an 80-column "lap" computer. Includes Wordstar, spreadsheet, 8 line display, and cassette drive.

$795



IBM

PC: 256K, 2 std drives	$1795
PC: 256K, 2 half-height TEAC drives	$1655
PORTABLE: 256K, 2 drives	$2345
XT: 256K, 10MB	$3335
AT: BASE CONFIGURATION (list $3995)	$3385
AT: w/20MB (list $5795)	$4985
•AT: w/40MB	$6150

LEADING EDGE PC AND FXD
Built by Mitsubishi

Compatibility Service Policy

If you buy a LE computer from Expert and you find any software or hardware that doesn't operate the same as it would on an IBM PC or XT, Expert will serve as a go-between to get the software or hardware modified to operate as advertised.

The exception is software distributed by IBM.

• Dual speed CPU • Parallel, serial, clock • 7 wide slots • MS-DOS 2.11, GW-Basic

One year warranty, nationwide service.

MONO PC-256: 2 Drives, 256K RAM, Mono w/Green	$1550
AMBER: Swap amber CRT for Green	$ 10
COLOR PC-256: 2 Drives, 256K RAM, Color with 13" RGB	$1895

FXD *models include a 10MByte fixed disk, and one 360K floppy drive. The savings is easily more than a $1000 vs. IBM XT with similar features.*

MONO FXD-256: 256K RAM, Mono/Green	$2225
AMBER: Swap amber CRT for Green	$ 10
COLOR FXD-256: 256K RAM, Color/RGB	$2570

Recommended Options:

LE Word Processing Software	$ 75
RAM Sets (384K installed)	$215
RAM-Disk and Print Spooler software	$ 55
Mono-Graphics Video: Like Hercules, includes 132x44 . . . swap	$290

COMPAQ

PORTABLE: 256K, 2 drives	$2245
PORTABLE **"PLUS":** 256K, 10MB	$3550
DESKPRO:	#2 - $2335 #3 - $3895 #4 - $5575

Compaq prices include green CRT.

NECAPC-III

Sooner or later a computer's value must depend on its speed of computation. By this measure, the APC-III is 3 times more computer than an IBM PC. This results from an 8086 CPU at 8 MHz. vs. IBM's 8088 at 4.7 MHz.

Standard package includes MS-DOS, GW-BASIC, one parallel, one serial, and 128K RAM.

#H102M 2 drives, mono	$1695
#H102C 2 drives, color	$1925
#H111M 10 MB, mono	$2595
#H111C 10 MB, color	$2785
#H107 128K RAM (256K max)	$ 275
#H108 128K RAM (expands #H107)	$ 145
#H110 colorgraphics board	$ 175
UNIX-MONO System: hard disk, 256K RAM, UNIX set	$3450
UNIX-COLOR System: above, with color	$3650

SANYO

Among the semi-compatibles, SANYO is still a best buy, largely due to the MicroPro no-extra-charge bundle.

MBC550-2: 1 drive, double sided	$ 720
MBC550-2E: Enhanced with 2 dsdd (360K each) drives	$ 880
MBC555-2: 2 drives, double sided	$1090
RAM: Additional 128K	$ 74
SANYO **SERIAL** PORT	$ 70
• ***TAXAN*** #415 RGB w/cable	$ 395
TEAC 558 drive w/instructions	$ 137
CAD: Drafting software	$ 95
COPYLINK: Modem software	$ 75
CPeMULATOR: Runs Kaypro format CP/M	$ 85
IBMTOSAN: Assists BASIC conversion	$ 59
SERIAL: Transfer utilities	$ 25
DUMP: Graphics to printer	$ 45

Complete list of Sanyo software - Send stamped, self-addressed envelope.

Prices may change – confirm by phone. 2% fee for VISA/MasterCard. 4% fee for American Express. 20% non-refundable deposit required on COD orders. California resident add sales tax. 15 DOA warranty: Call TECH/SERVICE to obtain return authorization – we will repair or replace at our option. This warranty is in addition to manufacturer's warranty.

Last Minute Software Selections

Borland Turbo Pascal - IBM	$45
Borland Turbo Pascal - Sanyo 55X	$45
Borland Turbo Toolbox - IBM	$45
Borland Sidekick - IBM (no copy)	$45
Borland Sidekick - IBM (copyable)	$75
Unisource Venix-86 (tested compatible with Leading Edge computers, Orchid Turbo-186, and 3-COM networks!)	$785

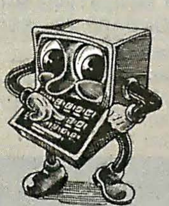
Star Micronics Powertype

20cps Daisywheel Printer

This is easily a better buy than Brother, Dynax, Abati, Juki, and generally any other "under $500" daisywheel.

- **Parallel and Serial interfaces**
- **Diablo ribbons and wheels**
- **Tractor is only $59**
- **13" Carriage**
- **2 Software Modes, Gemini and Diablo**
- **1 Year Warranty**

$345



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CCT-4 SYSTEM SERIES

The latest CCT implementation of the new generation Intel 16-Bit Processor technology. This means extreme speed, unequaled power, and the ultimate in reliability, and of course, the innovators at CCT behind it.

This series in the CCT line exploits the speed and power of the Intel 80286 and Zilog Z-80H (8MHz), on the 286Z CPU board. This combination, along with CompuPro DMA controllers and I/O boards, yields a dramatic improvement in system throughput speeds, from basic CP/M operation, up to large powerful multi-user/multi-tasking machines. The CCT-4 represents the most advanced hardware presently available in a microcomputer to run the thousands of CP/M type software programs on the market, and with CONCURRENT DOS 8-16 and the CompuPro PC Graphics board (when available), all software written for the IBM PC machines. This series is for the serious business/scientific user.

CCT-4A State-of-the-art power in it's basic form. Consists of CCT-286Z CPU board, along with CompuPro: Enclosure 2 Desk (21 slot MF), Disk 1A, System Support 1, Interfacer 4, Ram 22 (256K), the CCT-2.4 floppy drive system, and CP/M 80 and CP/M 86 . . . . . . **$5,995.00**

CCT-4B Single-user/hard disk power. As the 4A, except priced without the CCT-2.4, to add in your choice of CCT hard/floppy combination drive subsystem, at the published pricing. **$4,895.00**
(Example: CCT-4B Mainframe with CCT-10/1 = $7,244.00) Plus cost of selected drive subsystem

CCT-4C Multi-user/hard disk power. As the 4B, with the CCT M512 (512K static RAM board) instead of RAM 22; Interfacer 3 instead of Interfacer 4; and the addition of the MP/M 8-16 operating system. (6 user system) **$6,695.00**
(Example: CCT-4C Mainframe with CCT-40/1 = $10,044.00) Plus cost of selected drive subsystem

NEW RAM BOARD!

CCT BONUS ON 4C: FREE CONCURRENT DOS UPDATE!

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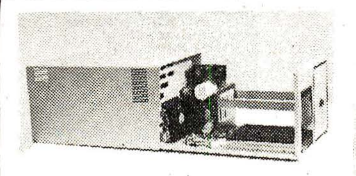
CCT-M512 CCT introductes it's 512K static RAM board. IEEE Standard 12MHz. 512K in one slot! **Introductory Price: $2,249**

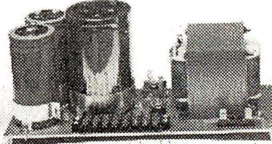
CUSTOM COMPUTER TECHNOLOGY / BOX 4160 / SEDONA, ARIZONA 86340

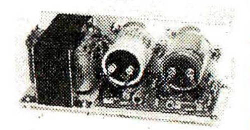
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ITEM		+5V OVP	* −5 or −12V	* +24 or +12V	+8V	±16V	SIZE W x D x H	PRICE
S_3	12 SLOT & 2 FLOPPY (1 Floppy & 1 Hard Disk)	5A	1A	5-7A PEAK	13A	3A	10" x 6" x 5"	105.95
S_4	6 SLOT & 2 FLOPPY	4A	1A	4-5A PEAK	8A	3A	8⅜" x 5" x 4¾"	95.95


S_3, S_4 for S-100 & 2 Drives

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ITEM	IDEAL FOR	+5V OVP	* −5 or −12V	* +24 or +12V	+8V Unreg.	±12V	SIZE W x D x H	PRICE
R_0	2 x 8" SLIMLINE	2.5A		2.5A - 5A Peak			5" x 4" x 4"	51.95
R_1	2 x 8" or 2 x 5¼" DISK	4A	1A	3A - 5A Peak	2A		8" x 4" x 3¾"	56.95
R_2	3 x 8" (or 5¼") FLOPPY	6A	1A	6A - 8A Peak			10" x 4⅞" x 3¾"	71.95
R_3	or 1x Floppy & 1x Hard	6A	1A	6A - 8A Peak		1A	9" x 6¼" x 4⅜"	98.95

AC & DC POWER CABLES WITH CONNECTOR FOR 2 DRIVES 8.00

SHIPPING FOR EA. PWR SUPPLY: $5.50 IN CALIF.; $8.00 IN OTHER STATES; $18.00 IN CANADA. FOR EA. TRANSFORMER: $5.00 IN ALL STATES; $12.00 IN CANADA. CALIF. RESIDENTS ADD 6.5% SALES TAX.

S-100 POWER SUPPLY KITS (OPEN FRAME WITH BASE PLATE, 3 HRS. ASSY. TIME)

ITEM	(IDEAL FOR)	+8V	−8V	+16V	−16V	+28V	SIZE: WxDxH	PRICE
KIT 1	15 CARDS	15A	---	2.5A	2.5A	---	12" x 5" x 4⅞"	54.95
KIT 2	20 CARDS	25A	---	3A	3A	---	12" x 5" x 4⅞"	61.95
KIT 3	DISK SYSTEM	15A	1A	3A	3A	5A	13½" x 5" x 4⅞"	69.95

POWER TRANSFORMERS (WITH MOUNTING BRACKETS)

ITEM	PRIMARY	SECONDARY #1	SECONDARY #2	SECONDARY #3	SIZE W x D x H	PRICE
T_1	110/120	2×8 Vac, 15A	28 Vac, CT, 2.5A	______	3¾" × 3⅝" × 3⅛"	22.95
T_2	110/120	2×8 Vac, 25A	28 Vac, CT, 3.5A	______	3¾" × 4⅜" × 3⅛"	28.95
T_3	110/120	2×8 Vac, 15A	28 Vac, CT, 2.5A	48 Vac, CT, 2A	3¾" × 4⅜" × 3⅛"	30.95
T_4	110/120	2×8 Vac, 6A	28 Vac, CT, 1.5A	48 Vac, CT, 3A	3¾" × 3⅝" × 3⅛"	23.95
T_5	110/120	2×8 Vac, 6A	28 Vac, CT, 2A	______	3" × 3" × 2½"	15.95

***R_1 COULD BE FACTORY MODIFIED TO +5V 3A, +12V 2.5A and −12V 1A. PLEASE SPECIFY WHEN ORDERING.**



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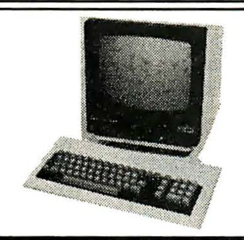
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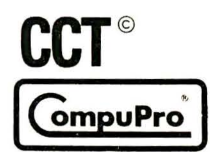
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☐ Introductory price - $1099.

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950 ...... $950 970 ...... $1099
Liberty Freedom 100 — $479 200 — $679
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Professionally engineered ST-506 type systems for the business market S-100 Computer user. Includes industry top quality drives, CompuPro Disk 3 DMA controller, all cabling, A&T, formatted, burned-in. Provisions for up to two hard disks in each system. We include operating system update. CP/M 80, CP/M 86, CP/M 8-16, MP/M 8-16, CP/M 68K. (/1 Systems are CCT innovated hard/floppy combinations, with Mitsubishi DSDD 8" drive.) 12 month warranty.

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CCT-20 (22 + MEG)	$2319	CCT-20/1	$2869
CCT-40 (36 + MEG)	$2799	CCT-40/1	$3349
CCT-60 (58 + MEG) (New)	$3999	CCT-60/1	$4549
CCT-90 (87 + MEG) (New)	$5209	CCT-90/1	$5759
CCT-125 (123 + MEG) (New)	$6399	CCT-125/1	$6949

Drive capacities shown are **after** formatting! We are working on tape cartridge back-up units.

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CCT-2.4 • Dual 8" DSDD
Mitusbishi 2.4 Megabyte in Extra Heavy horizontal enclosure, removeable filter air system, all cabling, A&T, Burned in. The fastest system available: $1229

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CP/M 8-16 (CCTTMX) - $199 • MP/M 8-16 (CCTSX) - $499 • CP/M 68K (CCTCX) - $279

16 Bit Upgrade Kit: CP/M 86, RAM 16, System Support 1, Cable $709 ☐ CP/M 8-16 - Kit - $733

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• FREE CONCURRENT DOS 8-16 UPGRADE (WHEN AVAILABLE) WITH PURCHASE OF MP/M 8-16 •

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• CPU 8085/88 - 6Mhz 8085/8Mhz 8088 •
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• Interfacer 4 - 3 Serial/2 Parallel I/O •
• CCT-2.4-Dual 8" Mitsubishi DSDD Drive System - 2.4 Megabytes •
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- ☐ IBM Parallel Cable 10' **$19.95**
- ☐ IBM Prototype Board (SUN-208) ... **$9.50**
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- ☐ Apparat EPROM Blaster **$129.00**
- ☐ IBM Up-Grade Kit (4164) .... **$35.00/per kit**

Apple Compatible Products

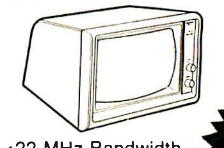
- SUN Z80 Card (w/o Software) **$55.00**
- SUN 80 Column Card (w/Soft switch) .. **$97.00**
- Power Supply (5 Amp) **$59.95**
- Cooling Fan **$42.00**
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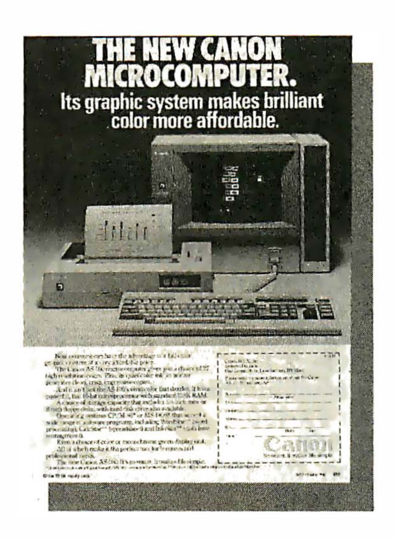
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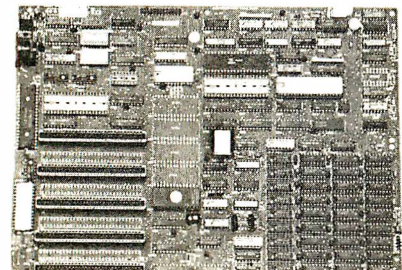
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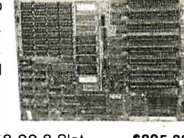
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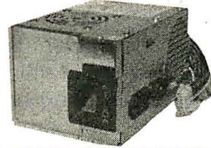
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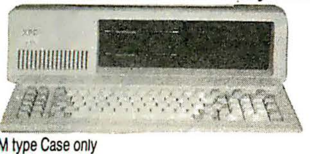
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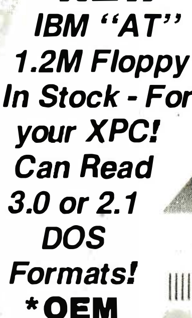
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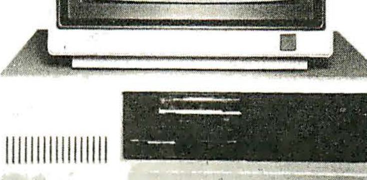
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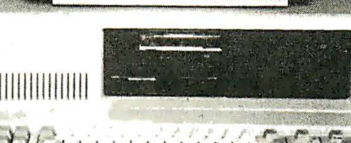
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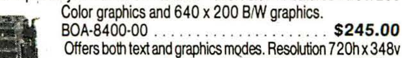
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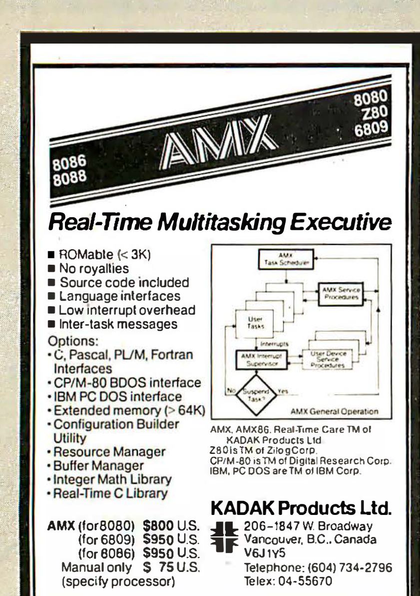
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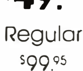
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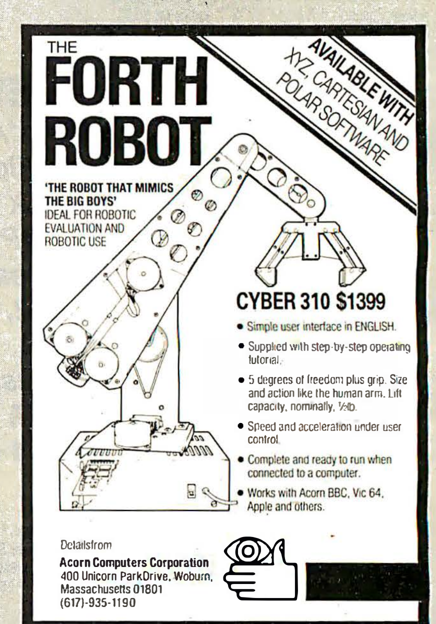
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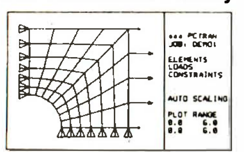
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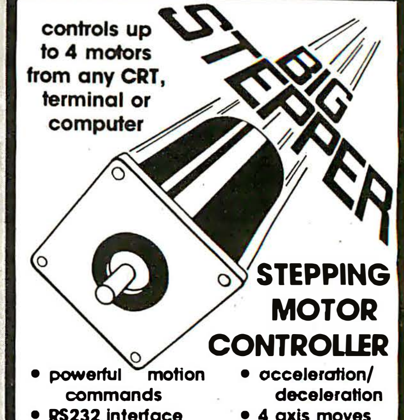
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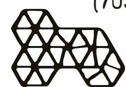
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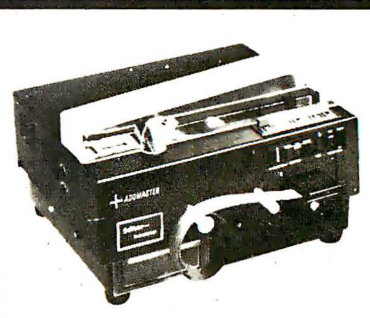
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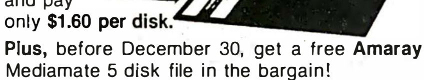
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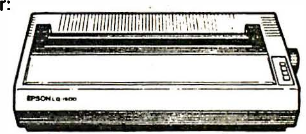
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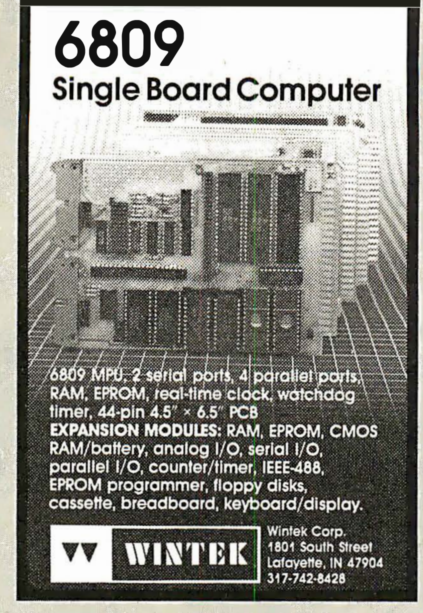
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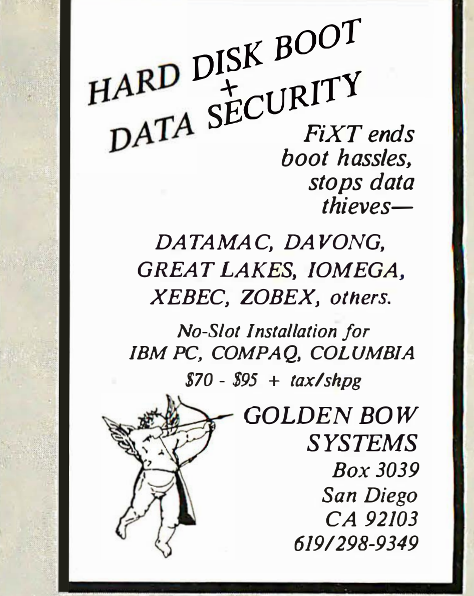
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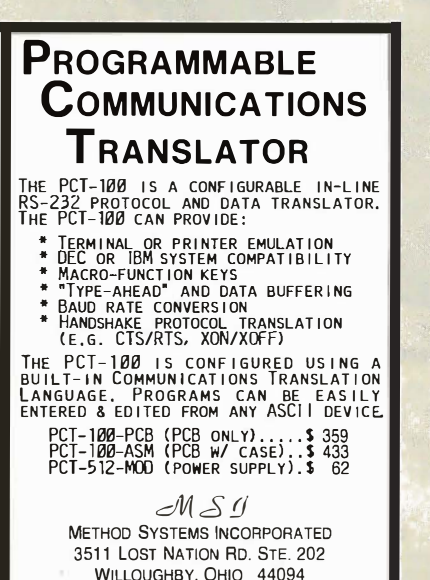
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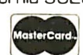
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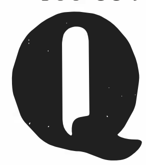
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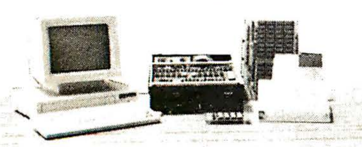
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7404	.19	7451	.19	74132	.45	74181	1.75
7405	.23	7453	.19	74136	.75	74182	1.15
7406	.49	7454	.19	74141	.65	74184	2.25
7407	.49	7459	.25	74142	2.95	74185	2.25
7408	.24	7460	.37	74143	3.70	74190	.67
7409	.19	7470	.29	74144	2.95	74191	.67
7410	.19	7472	.29	74145	.59	74192	.67
7411	.24	7473	.33	74147	1.49	74193	.67
7412	.38	7474	.34	74148	1.19	74194	.67
7413	.34	7475	.38	74150	1.09	74195	.87
7414	.49	7476	.34	74151	.55	74196	.75
7416	.49	7479	4.60	74152	.67	74197	.86
7417	.49	7480	.89	74153	.53	74198	1.15
7420	.19	7482	.95	74154	1.19	74199	1.15
7421	.35	7483	.45	74155	.69	74221	1.19
7422	.45	7485	.55	74156	.59	74251	.75
7423	.58	7486	.35	74157	.65	74273	1.65
7425	.29	7489	1.95	74158	1.65	74276	1.69
7426	.29	7490	.35	74159	1.58	74279	.75
7427	.25	7491	.65	74160	.69	74283	1.40
7428	.55	7492	.45	74161	.69	74284	2.90
7430	.18	7493	.35	74162	.69	74285	2.90
7432	.29	7494	.65	74163	.69	74290	1.49
7437	.25	7495	.50	74164	.69	74298	1.49
7438	.29	7496	.69	74165	.89	74365	.55
7439	.58	7497	2.70	74166	.85	74366	.55
7440	.19	74100	1.50	74167	2.75	74367	.55
7441	.79	74107	.24	74170	1.25	74368	.55
7442	.45	74109	.37	74172	4.75	74390	1.45
7443	1.15	74116	1.45	74173	.69	74393	1.33
7444	1.15	74121	.29	74174	.69	74490	2.25
7445	.68	74122	.44	74175	.69		

74LS00	$.26	74LS113	$.38	74LS247	$.74
74LS01	.25	74LS114	.39	74LS248	.96
74LS02	.25	74LS122	.45	74LS249	.96
74LS03	.25	74LS123	.95	74LS251	.59
74LS04	.33	74LS124	2.75	74LS253	.59
74LS05	.25	74LS125	.49	74LS257	.59
74LS08	.27	74LS126	.49	74LS258	.59
74LS09	.26	74LS132	.59	74LS259	2.95
74LS10	.25	74LS136	.39	74LS260	.59
74LS11	.33	74LS138	.59	74LS281	2.49
74LS12	.33	74LS139	.59	74LS266	.55
74LS13	.39	74LS145	1.19	74LS273	1.45
74LS14	.59	74LS148	1.36	74LS275	3.29
74LS15	.33	74LS151	.55	74LS279	.59
74LS20	.26	74LS153	.55	74LS283	.68
74LS21	.29	74LS154	1.49	74LS290	.88
74LS22	.29	74LS155	.69	74LS293	.76
74LS26	.29	74LS156	.69	74LS295	.96
74LS27	.29	74LS157	.69	74LS298	.88
74LS28	.29	74LS158	.69	74LS324	1.75
74LS30	.25	74LS160	.69	74LS347	1.95
74LS32	.33	74LS161	.69	74LS348	1.95
74LS33	.53	74LS162	.69	74LS352	1.25
74LS37	.35	74LS163	.69	74LS353	1.25
74LS38	.39	74LS164	.69	74LS363	1.29
74LS40	.25	74LS165	.90	74LS365	.48
74LS42	.44	74LS166	1.90	74LS366	.48
74LS47	.74	74LS168	1.15	74LS367	.45
74LS48	.74	74LS169	1.15	74LS368	.45
74LS51	.25	74LS170	1.40	74LS373	1.39
74LS54	.29	74LS173	.67	74LS374	1.33
74LS55	.29	74LS174	.67	74LS375	.69
74LS73	.39	74LS175	.67	74LS377	1.38
74LS74	.34	74LS181	1.95	74LS385	1.95
74LS75	.39	74LS190	.85	74LS386	.45
74LS76	.39	74LS191	.85	74LS390	1.15
74LS78	.39	74LS192	.76	74LS393	1.15
74LS83	.59	74LS193	.78	74LS395	1.15
74LS85	.69	74LS194	.69	74LS399	1.47
74LS86	.39	74LS195	.69	74LS424	2.95
74LS90	.54	74LS196	.79	74LS668	1.75
74LS92	.54	74LS197	.79	74LS670	2.29
74LS93	.54	74LS221	.89	81LS95	1.45
74LS95	.75	74LS240	.95	81LS96	1.45
74LS96	.89	74LS242	.95	81LS97	1.45
74LS107	.39	74LS243	.95	81LS98	1.45
74LS109	.39	74LS244	1.29	25LS2521	2.65
74LS112	.39	74LS245	1.45	25LS2569	3.50

CMOS

4000	$.29	4026	$.65	4059	$7.90	4505	8.95
4001	.24	4029	.75	4060	.65	4506	1.10
4002	.24	4030	.39	4066	.39	4507	1.10
4006	.79	4031	3.25	4069	.26	4508	1.90
4007	.25	4032	2.15	4070	.35	4510	.79
4008	.95	4034	1.91	4071	.26	4511	.79
4009	.39	4035	.79	4072	.26	4512	.79
4010	.39	4037	1.95	4073	.26	4514	1.18
4011	.24	4040	.75	4075	.26	4515	1.79
4012	.24	4041	.75	4076	.75	4516	1.19
4013	.35	4042	.65	4077	.35	4518	.65
4014	.75	4043	.65	4078	.35	4520	.75
4015	.39	4044	.69	4081	.29	4555	.95
4016	.35	4046	.60	4082	.29	4556	.95
4017	.65	4047	.69	4085	.95	4586	1.35
4018	.79	4048	.99	4086	.95	80C95	1.50
4019	.39	4049	.35	4093	.45	80C97	1.25
4020	.69	4050	.34	4094	2.95	MC14408	12.95
4021	.69	4051	.75	4098	1.90	MC14409	12.95
4022	.69	4052	.75	4099	1.65	MC14410	12.95
4023	.25	4053	.75	4501	.69	MC14411	11.95
4024	.59	4055	3.95	4502	.95	MC14412	12.95
4025	.25	4056	2.95	4503	.62	MC14419	4.95
4027	.45						

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74S00	$.35	74S74	$.55	74S158	$.99	74S260	$1.19
74S02	.35	74S85	1.89	74S160	2.49	74S280	1.95
74S03	.35	74S86	.55	74S161	1.69	74S267*	1.95
74S04	.45	74S112	.55	74S174	1.19	74S288*	1.95
74S05	.45	74S113	.55	74S175	1.19	74S373	2.09
74S08	.39	74S114	.55	74S188*	1.49	74S374	2.09
74S09	.39	74S124	2.69	74S194	1.49	74S387*	1.95
74S10	.35	74S132	1.39	74S195	1.49	74S471*	5.95
74S11	.35	74S133	.45	74S196	1.49	74S472*	4.95
74S15	.35	74S134	.50	74S240	1.99	74S473*	4.95
74S20	.35	74S135	.69	74S241	1.99	74S474*	4.95
74S22	.35	74S136	1.39	74S242	1.99	74S475*	4.95
74S30	.35	74S138	.89	74S243	1.99	74S570*	2.95
74S32	.45	74S139	.89	74S244	1.99	74S571*	2.95
74S38	.69	74S140	.55	74S251	1.19	74S572*	4.95
74S40	.39	74S151	.99	74S253	1.19	74S573*	4.95
74S51	.35	74S153	.99	74S257	1.19	74S940	2.49
74S64	.39	74S157	.99	74S258	1.19	74S941	2.49
74S65	.39						

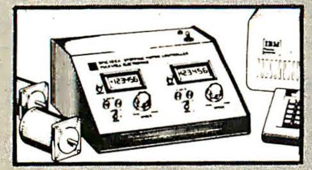
74C00

74C00	$.35	74C74	$.65	74C161	$1.15	74C373	$2.35
74C02	.35	74C85	1.89	74C175	1.15	74C374	2.35
74C04	.29	74C90	1.15	74C240	1.69	74C901	.59
74C08	.35	74C93	1.15	74C244	1.69	74C922	4.45
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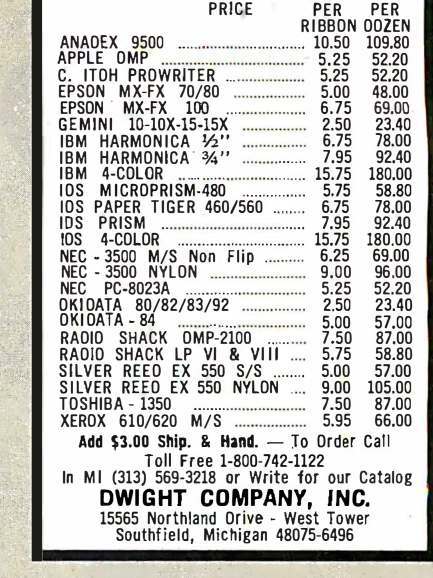
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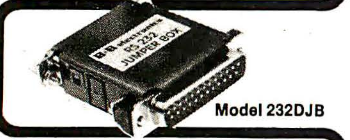
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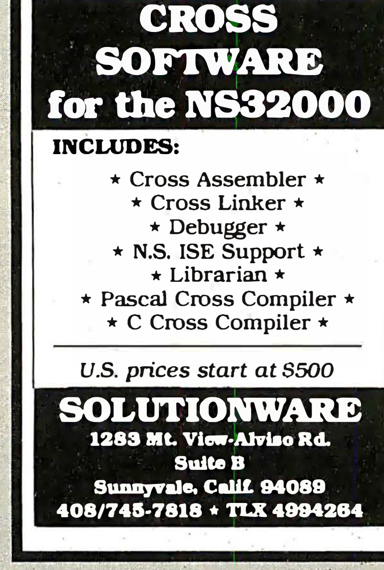
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74LS02	.25	74LS169	1.35
74LS03	.25	74LS170	1.35
74LS04	.30	74LS173	1.35
74LS05	.25	74LS174	.85
74LS08	.30	74LS175	.90
74LS09	.30	74LS181	2.50
74LS10	.25	74LS190	1.45
74LS11	.30	74LS191	1.45
74LS12	.30	74LS192	1.45
74LS13	.75	74LS193	1.45
74LS14	.75	74LS194	1.45
74LS15	.35	74LS195	1.45
74LS20	.25	74LS196	1.35
74LS21	.30	74LS197	1.35
74LS22	.30	74LS221	1.35
74LS26	.30	74LS240	1.85
74LS27	.30	74LS242	1.85
74LS28	.30	74LS243	1.85
74LS40	.30	74LS244	2.25
74LS42	.35	74LS245	3.95
74LS48	.35	74LS247	1.65
74LS51	.35	74LS248	1.65
74LS54	.35	74LS249	1.65
74LS55	.35	74LS251	1.75
74LS73	.35	74LS253	1.75
74LS74	.45	74LS258	1.50
74LS75	.45	74LS259	2.95
74LS76	.45	74LS260	1.15
74LS78	.75	74LS261	3.75
74LS83A	.75	74LS266	1.35
74LS85	.75	74LS273	1.75
74LS86	.35	74LS275	1.95
74LS90	.75	74LS279	.75
74LS92	.75	74LS283	.75
74LS93	.75	74LS290	.75
74LS95	.75	74LS293	1.25
74LS96	.75	74LS295	1.65
74LS107	.35	74LS298	1.65
74LS109	.45	74LS323	2.95
74LS113	.75	74LS324	1.15
74LS114	.75	74LS347	1.55
74LS122	.95	74LS348	1.45
74LS123	.95	74LS352	1.65
74LS124	.95	74LS353	1.95
74LS125	.75	74LS363	1.95
74LS126	.75	74LS365	1.25
74LS132	.95	74LS366	1.25
74LS133	.75	74LS367	.95
74LS136	.75	74LS368	.95
74LS138	.95	74LS373	1.95
74LS139	.95	74LS374	1.95
74LS145	.95	74LS375	.95
74LS148	.95	74LS377	.95
74LS151	.75	74LS378	1.55
74LS153	.75	74LS379	1.55
74LS154	.95	74LS381	1.95
74LS155	.75	74LS385	1.95
74LS156	.75	74LS386	1.25
74LS157	.75	74LS390	2.55
74LS158	.75	74LS393	1.55
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74S00	.30
74S02	.30
74S03	.30
74S04	.35
74S05	.35
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74S09	.65
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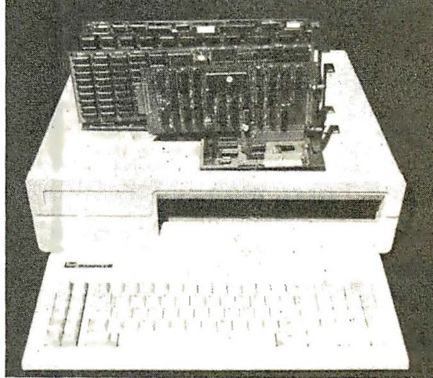
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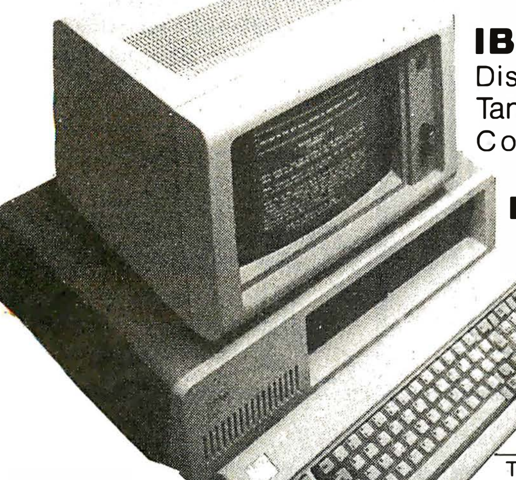
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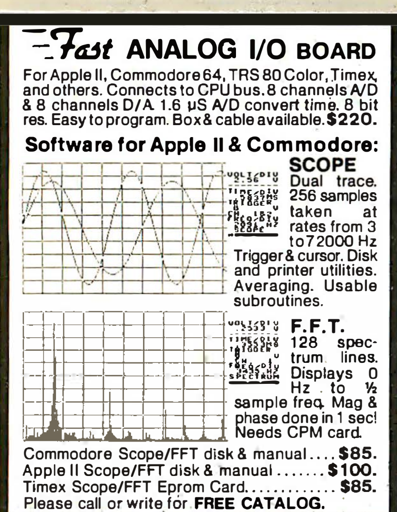
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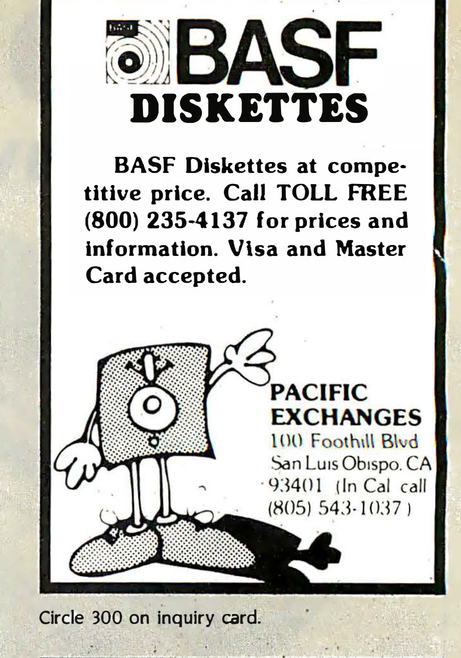
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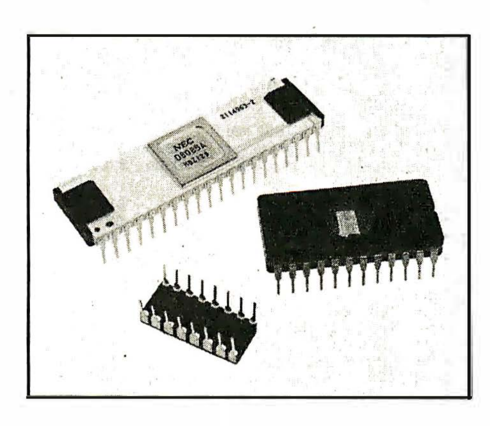
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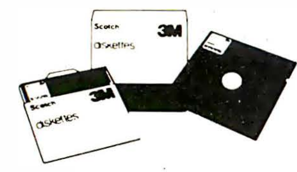
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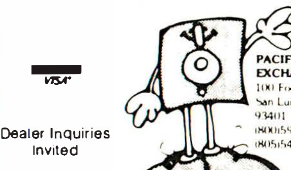
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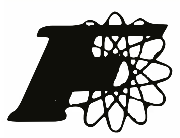
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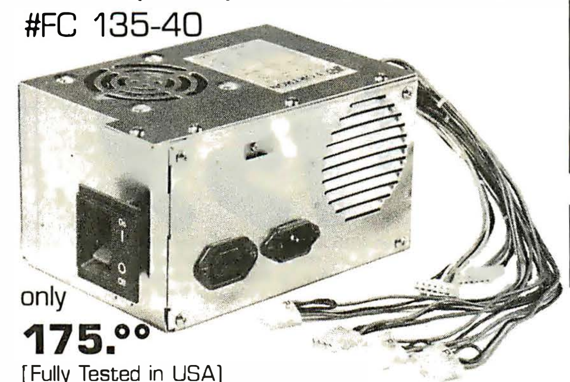
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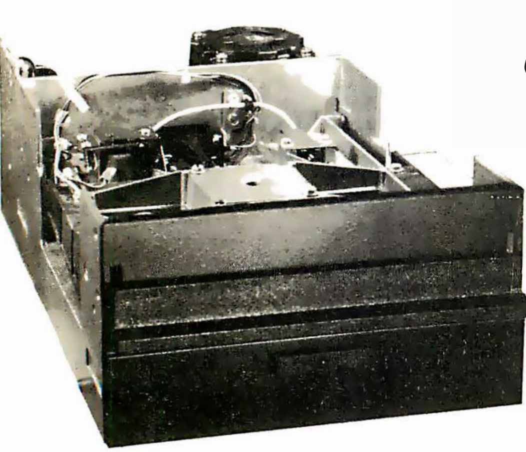
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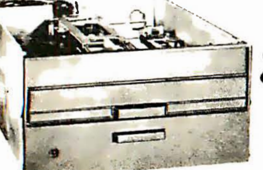
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NEC JC1401D Medium/High 13 RGB	NEC-1401/X	25900
BMC AU9191U Color composit video with sound	BMC-9191	23895
BMC 9191M RGB designed for use with the IBM computer	BMC-9191M	37900
NEC JC1203DM. RGB color monitor	NEC-1203	69900
NEC JC1201 color composit	NEC-JC1201	339.00
Zenith ZVM135 RGB & composite suitable for IBM PC	ZTH-Z135	475.00
Amdek Color I 13 composit video	AMK-100	29900
Amdek Color II - 13 RGB hi-resolution	AMK-200	41995
Amdek Color III - 13 RGB. medium resolution	AMK-300	359.95
Princeton HX-12 RGB IBM/PC compatible	PRN-HX12	47895

PRINTERS

MATRIX PRINTERS

Star Gemini-10X 120 char/sec	STR-G10X	25900
Star Gemini-15X. 100 char/sec 15 paper	STR-G15X	36500
Star Gemini Delta 10. 160 Char/sec	STR-D10	399.00
Star Coex 80FT friction & tractor	VST-C80FT	179.00
Toshiba P1351. 192 char/sec letterquality	TOS-1351	149500
Okidata 82A serial & parallel 9½ paper	OKI-82A	32900
Okidata 92A parallel interface. 160 char/sec	OKI-92A	399.00
Okidata 83A & parallel 15 paper	OKI-83A	55900
Okidata 84A & parallel 15 paper	OKI-84A	92900
Epson RX-8010 120 Char/sec	EPS-RX80	259.00
Epson FX80. 10 160char/sec with graphtrax	EPS-FX80	43900
Epson FX 100 15 160char/sec with graphtrax	EPS-FX100	62900
Epson LQ1500. 15 corespondencequality	EPS-LQ1500	117900
Epson JX80 Color printer	EPS-JX80	57900
Anadex 9501B high speed with graphics	ADX-9501B	102900
Anadex 9620B 200 char/sec par'l & serial	ADX-9620B	112900
Prowriter 8510 parallel 9½ paper	PRO-8510P	35900
Prowriter II. parallel 15 paper. graphics	PRO-2P	689.00
Dataproducts B-600-3. band printer 600 LPM	DPS-B600	698500
Printronix P300 high speed printer 300 lines per minute	PTX-P300	399500
Printronix P600 ultra high speed 600 lines per minute	PTX-P600	579500

WORD PROCESSING PRINTERS

NEC7710 55 char/second. serial interface	NEC-7710	1795.00
NEC7730 55 char/sec. par'l interface	NEC-7730	1795.00
NEC3550 popular printer designed for the IBM/PC	NEC-3550	1599.00
NEC2050 designed for IBM/PC 20 char/sec par'l	NEC-2050	995.00
Silver Reed EXP500. 14 char/sec par'l interface	SRD-EXP500	459.00
Silver Reed EXP550 17 Char/sec par'l interface	SRD-EXP550	659.00
Diablo 630 40 char/sec serial	DBL-630	1765.00
Diablo 620. proportional spacing. horz & vert tab 20 cps	DBL-620	775.00
Juki 6100. 18 char/sec SPECIAL	JUK-6100	429.00
Brother HR1A serial interface	BTH-HR1S	695.00
Starwriter F10 serial. 40 char/sec	PRO-F10S	1125.00
Starwriter F10 parallel 40char/sec	PRO-F10P	1125.00
Comrex CR2 5k buffer. proportional spacing. par'l	CRX-CR2P	495.00

TERMINALS

Freedom 100. split screen. detatchable keyboard	LIB-F100	495.00
Qume 102 green phosphor terminal	QUM-102	539.00
Ampex Dialogue 125 green screen.	APX-D125G	675.00
Ampex Dialouge 175 amber screen. two page. func. keys	APX-D175A	719.00
Wyse 50. 14" green phosphor	WYS-50	595.00
Wyse 300. Eight color display. split screen.	WYS-300	1159.00
Zenith 29 terminal. VT52 compatible. detatchable keyboard.	ZTH-Z29	765.00
Televideo 910 Plus. block mode	TVI-910P	575.00
Televideo 925. detatchable keyboard. 22 function keys	TVI-925	759.00
Televidoo 950.graphicchar..splitscreen.22 func.	TVI-950	950.00
Televideo970. 14" green. 132 column. European	TVI-970	1095.00



TeleVideo $795

The Televideo TPC/1 portable micro is a full featured computer with the advantage of portability. The 9 inch amber phosphor offers easy readability and a non-glare surface for easy on the eyes screen display. TPC 1 has an IBM style. low profile keyboard. detachable for comfortable data input which folds up to make a compact carrying case. The alpha numeric displayed character set includes 96 ASCII characters. 32 control codes. along with 10 programmable function keys. This unit feature two double sided 320 K/byte disk drives. Z80 microprocessor and provides 64K of user RAM along with 32K of screen memory. The standard software package includes Telewrite exclusive word processor. Telecalc spreadsheet. Telechart business graphics and CPM operating system which makes the portable compatible with the largest library of microcomputer software available



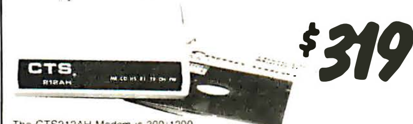
Return of a Smash Hit Sellout DRAGON $139

Compatible with most Radio Shack Color Computer software. The world famous Dragon computer is now available in the United States. Manufactured by the Tano Corp. under license of the British Broadcasting Company. The Dragon comes complete with 64K Byte of memory, serial modem port along with a Centronics printer interface. This unique microcomputer features Motorola's advanced 6809E microprocessor and comes standard with Microsoft Color Basic, data base manager, and a complete word processing package. The computer outputs color composite video along with R.F. video that allows the unit to be used in conjunction with any color television. This is the ideal low cost computer to be used with any dial up information system such as the Source. Western Union's EasyLink or any other time share service.

California Digital has agreed to act as exclusive agent for North America in an effort to assist The Tano Corporation in reducing their overstock. For a limited time California Digital can offer the Dragon computer for only $139.

MODEMS

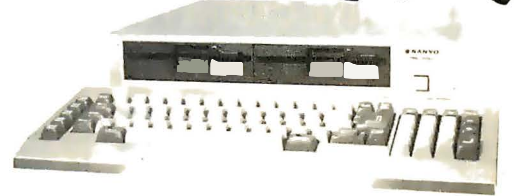
$319



The CTS212AH Modem is 300/1200 Auto Answer/Auto Dial. Hayes Compatible. Mycroft Labs Companion communications software $35.00 additional

CTS 212AH 1200 baud. auto dial	CTS-212AH	319.00
Signalman Mark 12. 1200 baud. Hayes compatible	SGL-MK12	259.00
Signalman Mark 1. direct connect with terminal cable	SGL-MK1	75.00
Hayes Smart Modem 1200 baud. auto answer. auto dial	HYS-212AD	479.00
Hayes 1200B for use with the IBM/PC. 1200 baud	HYS-1200B	429.00
Hayes Smartmodem. 300 baud only. auto answer. auto dial	HYS-103AD	229.00
Hayes Micromodem II. 103 Apple direct connect	HYS-MM2	279.00
Hayes Chronograph. time & date	HYS-CHR232	199.00
U.S. Robotics 212A 300/1200 baud. auto dial/answer.	USR-212A	439.00
U.S. Robotics Password 300/1200 baud	USR-PW212	389.00
Penril 300/1200 industrial quality	PEN-12AD	595.00
Universal Data 103LP. line power. answer & originate	UDS-103LP	169.00
Universal Data 202. 1200 baud. half duplex only	UDS-202LP	219.00
Universal Data 212LP. full 1200 baud duplex. line power	UDS-212LP	359.00
Novation 'J' Cat. direct connect. auto answer	NOV-JCAT	115.00
Novation SmartCat 103/212. 1200 baud auto dial	NOV-SC212	529.00

SANYO IBM Compatible $759

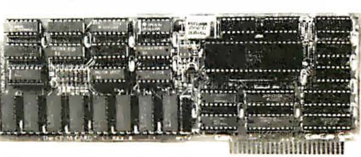


The Sanyo MBC-550 Microcomputer includes 128K byte of memory, a 5¼" disk drive along with a parallel printer port. The computer outputs both RGB color and monochrome composite video. Extensive software such as Sanyo Basic, Wordstar, Calcstar and Easy Writer I is included with the MBC-550.

Sanyo 550	**reduced SALE price**	**759.00**
Sanyo 550 Plus	**two single sided drives**	**829.00**
Sanyo 550-2	**one double sided drive**	**949.00**
Sanyo 550-2 Plus	**two double sided drives**	**1095.00**
Sanyo 555	**two sgl. drives, bonus soft.**	**1095.00**
Sanyo 555-2	**two dbl. drives, bonus soft.**	**1249.00**
Memory Upgrade	**256K total memory**	**99.00**
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33 MB	$1689	$1889

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III DTL-002 Holds 2 ea. 8" Thinline W/P.S. $169
III FDE-002 2 ea 8" Std Size Horizontally w/P.S. $189
OTC DDC88V28 Holds 2 ea. 8" Std Size/Vert. w/P.S. $289

5¼" CABINETS

*Note - All P.C. Products Units Available w/Extender Connector for $15 ea.

III HD 5-001 w/P.S. got 2 Thin line Hard Disk .. $189
III HD 5-002 w/P.S. for 2 Full Size Hard Disk or Tape Back-up $209
JMR DDC5H w/P.S. Horiz. for 1 ea. Std. Size $55
P.C. DDC5V P.S. Vert. for 1 ea. Std. Size $55
P.C. DDC55V w/P.S. Vert. for 2 ea. Std. Size $85

SLIMLINE 5¼" CABINET

JMR DDC55H 1/2 w/P.S. Horiz. for 2 ea. 1/2 HGT $75
P.C. DDC55V 1/2 w/P.S. Vert. for 2 ea. Drives $75

PRINTERS

Daisywriter 2000-48K Buffer, 20 to 40 CPS Ltr Qual. $999
Diablo 620 API (25CPS) $749
Diablo 630 API (40CPS) $1549
Diablo 630 ECS/IBM or API $1649
Epson FX-80 (160 CPS - 10" - Graphtrax/Tractor) $399
Epson FX-100 (160 CPS - 15" - Graphtrax/Tractor) $649
Juki 6100 (18 CPS - Diablo Compatible Daisywheel) $419
Juki 6300 (40 CPS - 16" - 3K Buffer Upgrade to 15K) $799
Okidata 82a (120CPS -10") $319
Okidata 83a (120CPS - 15") $569
Okidata 92a (160CPS - 10") $399
Okidata 93a (160CPS - 15") $649
Okidata 84p (200CPS - 15") $729
Okidata 84S (200CPS - 15") $849
Okidata 2350P $1895
Okidata 2410P $1895
Panasonic 1091 (120 CPS - Logic Seeking Head - Runs Faster than FX-80-Par Port - Double Strike Switch - with Tractor $299
Star Gemini 10X (120CPS - 10") $268
Star Gemini 15X $399
Star Gemini Powertype (18 CPS Ser or Par) $399
Toshiba P-1351 (192CPS/120CPS Ltr) $1299

PRINTER ACCESSORIES

Daisywriter 2000 B1-D1 Tractor $210
Diablo 620 Tractor $189
Diablo 630 Tractor $210
Juki 6100 Tractor $139
Juki 6100 Serial Interface $65
Okidata 82/92 Tractor $60
Okidata Serial Interface w/2K Buffer (92 & 93) $129
Okidata Okigraph I $55
Okidata Okigraph II $60
Star Gemini 10X or 15X Serial Board w/4K Buffer $129
Toshiba 1351 Tractor Feed $195

PRINTER SWITCHER

Allows you to switch from letter quality to Dot Matrix by flip of switch

SCN-2/Two Position Centronics Par to Centronics Par $99
SCN-4/Four Position Cen Par to Cen Par $139
SRS-2/Two Position Serial to Serial $89
SRS-4/Four Position Serial to Serial $129

CABLES

IBM to Par Cable $22
Centronics to Centronics $24
RS232 Serial (Specify) $16
Columbia to Par $28
IBM Add-on Drive (DC37 Conn) $34
Disk Drive Cable 5" or 8" $26
Y-Splitter Cable $7.95

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MBC 555-2 - 128K RAM (Expands to 256K) 2 ea. DS/DD 1/2 HGT Drive, Par port, Speaker and joystick port, Display, Keyboard & Following Software:

Wordstar	Mailmerge
Easywriter	Spellstar
Calcstar	Infostar

MS-DOS 2.11 .... $1,149

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Sanyo Serial Port $65
128K Memory Expansion for Sanyo $69
RGB Cable $19.95
Copylink Software (US Digital for Modem) $89

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QT 8" MAINFRAME




- Provision for any 2-8" drives (hard or floppy)

Desk Top Version
QTC-MF + DD6 (6 Slot MB) $575
QTC-MF + DD8 (8 Slot MB) $625
QTC-MF + DD12 (12 Slot MB) $675

All mainframes have EMI filter, 2 AC outlets, 15 ea. DB25, 2ea. 50 pin, 2 ea. 34 pin, 1 ea. Centronic cutouts, power supply for 8" MF (-5V1A/+5V5A/+8V14A/+16V3A/+24V5A)

QT STANDARD MAINFRAME



•Provisions for any 2-5¼" drives•15 ea DB 25 cutout •2 ea 50 pin•2 ea 34 pin•1 ea Centronic•EMI filter (fused)•2 AC outlets•Avbl with 6-8-12-18 or 22 slot MB•Power supply (+8V16A-16V3A)

Desk Top Version
QTC-MF + 12 .... $499
QTC-MF + 18 .... $525
QTC-MF + 22 .... $550

CARD CAGES/MOTHERBOARDS

IEEE-696-No termination required

Slots	Bare Bd	A + T	w/card cage	bare card cage
4	$20	51.75	74.75	$20
6	$25	60.95	86.25	$22
8	$30	85.10	120.75	$31
12	$35	119.60	166.75	$41
18	$50	178.25	235.75	$50
22	$65	218.50	—	$75

All card cages will accommodate a 4" fan
Add $20.00 for 1 fan - Add $30.00 for 2 fans

CLOCK/CALENDAR

S-100•Time in hrs. min, sec.•AM/PM or Military Format•Date in Mo., Day, Yr., Day of Week & Leap Year recognition•4 hard interrups (1024 Hz, 1 Hz 1 min, 1 hr)•On board battery (will last 14 mos. w/no power on)

QTC-CCS-BB (S-100) $45
QTC-CCS-A (A+T) for S-100 .... $105

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Best Bare Board Set Available
QTC-SBC 2/4 CPU (SBC 880)
QTC-EXP + III 256K (CT256) Memory bd./ Expandable to 1 MG
QTC-FDC 5/8 Floppy disk controller
Bare Board Set $165
1) Includes manuals & assembly instructions
2) Parts available 3) Monitor & B10S available

DISK DRIVES

	1	2	10
CDC			
CDC 9409 DS/DD 360K	199	190	180
CDC 9409T Quad 720K	239	199	190
MPI			
B-52 DS/DD 360K	100	95	90
MITSUBISHI			
M-2894-63 8" Stds 123/DS/DD/ 1.2 MG	419	390	380
M-2894-63 8" Thin-line/DS/DD/ 1.2 MG	419	390	380
M-4853 1/2 HGT	169	159	140
QUME			
142 DS/DD 360K 5" 1/2 HGT	169	165	160
842 or **DT-8** DS/DD 1.2 MG 8" Full Size	449	440	430
SHUGART			
SA400 SS/DD 160K 5" Full Size	179	169	160
SA455L DS/DD 360K 5" 1/2 HGT	155	145	140
SA801R SS/DD 600K 8" Full Size	349	330	320
TANDON			
TM100-1A SS/DD 160K 5" Full Size	150	140	130
TM100-2A DS/DD 360K 5" Full Size	155	145	140
TM-101-4 Quad 720K 5" Full Size	280	270	260
TEAC			
FD55B DS/DD 360K 1/2 H	135	129	119
FD55F Quad 720K 1/2 H	169	159	149








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IBM PC-1 Includes 64K RAM, 1 ea 360K FD	$1329
IBM PC-2 64K RAM, 2 ea 360K FD	$1499
IBM PC-22 256K RAM, 2 ea 360K FD	$1699
IBM PC-3 256K RAM, 2ea 360K FD, IBM Mono Display, IBM Mono Card	$1999
IBM PC-33 256K RAM, 2 ea 360K FD, Color Bd. Monitor	$1899
IBM PC-4 256K RAM, 2ea 360K FD, STB Graphics+ Princeton HX-12	$2429

FLOPPY CONTROLLERS

FDC (5" Only)	$140
FDC-P (5" w/Par Port)	$190
FDC-S (5" w/Serial Port)	$210
Sandstar FDC (5" & 8" w/ability to add following modules)	$200
Modules - Parallel Mod	$55
Serial Port Mod	$75
Clock-Cal Mod	$65
Game Mod	$45
Hard Disk Module	$299

KEYBOARDS

KB-5150	$179
KB-5151	$199

MEMORY BOARDS

AST RESEARCH

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6 Pak+ w/384K Plus all above features	$469

P.C. WARE

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"256K RAM" w/64K RAM	$159

QUADRAM

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"Quadboard 384" w/384K and all above features	$479

MONITORS

IBM Color Display	$549
IBM *Monochrome* Monitor	$249
AMDEK 300A	$149
AMDEK 310A (for IBM)	$169
AMDEK 600 RGB Hi-Res	$499
AMDEK 700 RGB Ultra Hi-Res	$595
Princeton HX-12 Hi-Res	$489

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PCjr-3 All features of "Enhanced Model" Plus IBM Color Monitor. Free Software includes Basic Cartridge, Word Processor and DOS 2.1	$1239
PCjr-4 All features of "Enhanced Model" Plus IBM Color Monitor and Internal Modem Free Carrying Case and Software	$1499

PCjr ACCESSORIES

	list	our price
Color Display	$429	$365
Printer Adapter	$99	$87
Compact Printer (Thermal)	$175	$160
Half Height 360K Disk Drive	$480	$399
Serial Adapter Cable	$25	$23
Color Display Cable	$20	$18
Keyboard Cord	$20	$18
TV Connector	$30	$28
Carrying Case	$60	$55
Game Control Adapter	$45	$41
Joystick	$40	$36
Hands on Basic	$17.50	$16
Basic Cartridge	$75	$70
Internal Modem	$199	$175
Mouse	$195	$175
Additional Memory	$295	$250

PC POWER SUPPLIES

HDPC-X Pwr - External Power Supply (130w) for Hard Disk Add-ons w/fan	$169
HDPC-I Pwr - Internal Power Supply (130w to Replace 63w)	$189

NOTE! "All hard disks above 10MB require 130w power supply"

IBM HARD DISK SYSTEMS

IBM XT 128K RAM, 10 MB Hard Disk, & Keybd	$3495
PC-10 256K RAM, 10MG H.D., 1 ea 360K FD and Keybd	$2499
PC-10/2 256K RAM, 10MG HD, 2 ea 1/2 Hgt 360K FD and Keybd	$2699
PC-10/2M 256K RAM, 10 MG HD, 2 ea 360K FD, Amdek 310a, IBM Monocard, Keybd	$2995

IBM-AT SYSTEMS

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IBM-AT (Base Model) includes 256K RAM, 1.2 MB F.D., Clk/Cal, 8 Slots, Keylock	$3900
IBM-AT (Enhanced) includes 512K RAM, 1.2 MB FD, 20 MB Fixed Drive, Ser/Par Port, 8 Slots, Keylock	$5700

MODEMS

Anchor Mark XII - External-Direct Connect-Hayes Commands Includes Serial Cable-Auto Answer & Dial	$239
Hayes 300 - External-Direct Connect	$199
Hayes 1200 - External-Direct Connect	$499
Hayes 1200B - Internal for IBM with Software	$399
Pro-Modem 1200 - External-Direct Connect-w/Clock - Hayes Commands - Auto Answer and Dial	$339
Quadmodem 1000 - External - Direct Connect - 1200 Baud - with Software	$329
Quadmodem 1100 - Internal - 1200 Baud - with Software	$289

VIDEO CARDS

Mono Cards

IBM Monochrome Card	$229
Hercules Graphics Card	$349

Color Cards

Paradise Mono & RGB w/Par Port 640X200 B&W 320X200 (4 Color) Flicker Free - Mono to Color Switch	$319
Quadcolor 1 - Composite and RGB	$209
Quadcolor 2 - Piggyback Upgrade for Quadbd 1	$209
STB Graphics Plus - Composite, Mono 50% Faster Scroll, Lite Pen Intfce, Flicker Free, Par Port Runs all Software	$349
Tecmar Graphics master - 128K Display RAM On Low Scan (640X400V) (16 color) (720X480V) (4 Color)	$549
Everex - **"The Graphics Edge"** (80X25 or 132X44) Runs Mono and Color Simultaneously - (640X200V) 16 Color Par Port	$399

IBM MISCELLANEOUS PRODUCTS

IBM Memory Upgrade Kit (64K)	$34
P.C. Ware Serial Board	$79
P.C. Ware Par Board	$75
P.C. Ware Clock/Calendar	$59
Math Co-Processor - 8087	$159
IBM DOS 2.1	$57
IBM DOS 3.0	$60



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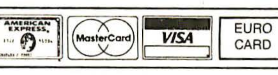
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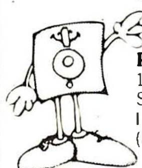
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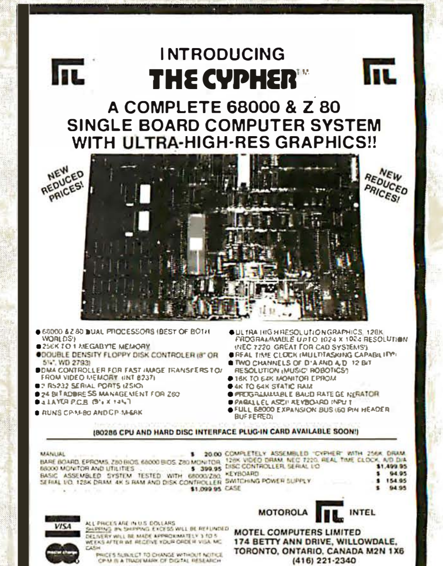


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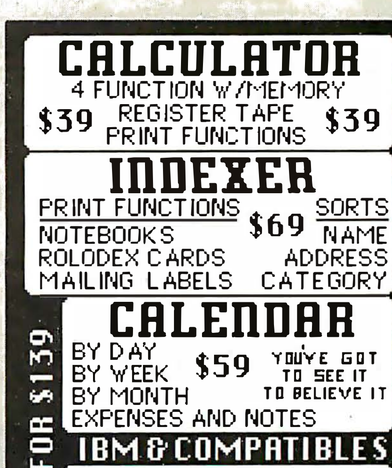
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Systems

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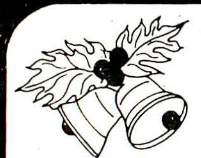
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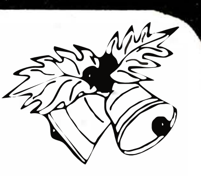


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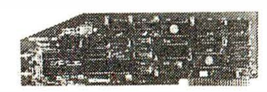
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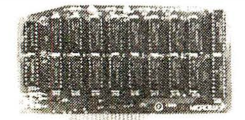
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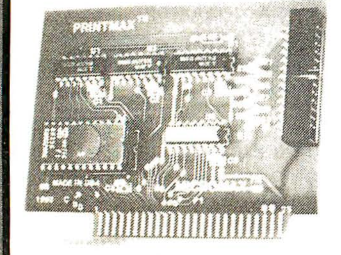
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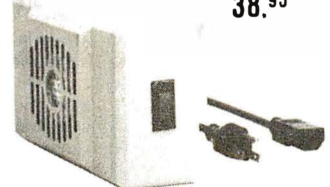
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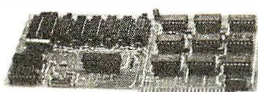


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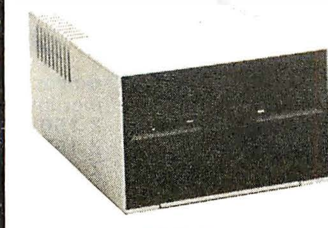
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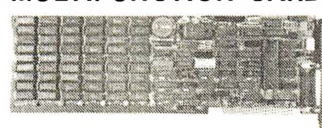
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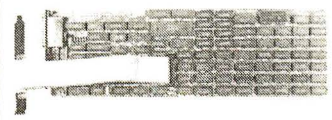
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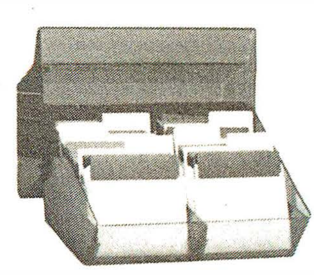
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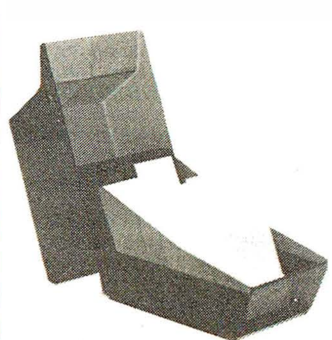
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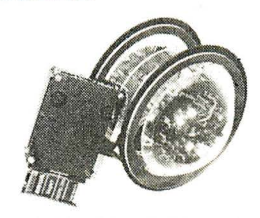
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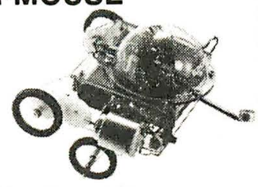
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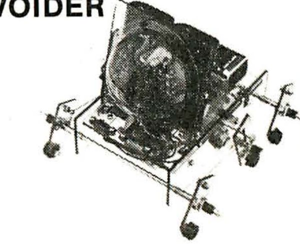
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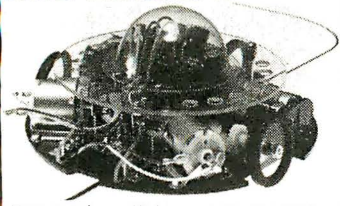
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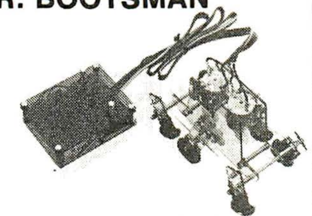
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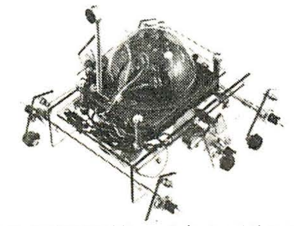
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MV-931 $32.95

TURN BACKER



When its about to hit a wall, just yell "Look Out!" and the robot automatically turns left. Requires 4 "AA" batteries (not included).

MV-911 $39.95

MEMOCON CRAWLER



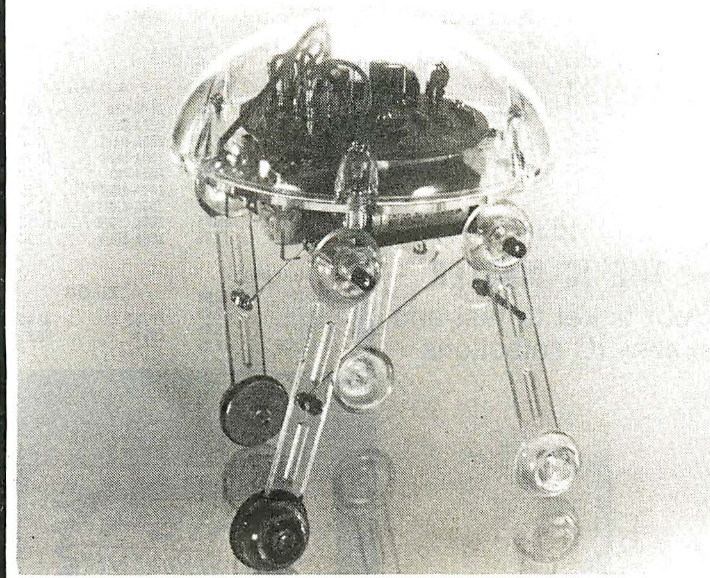
Runs through the program you input on the included keyboard: forward, turn right or left, pause, sound buzzer or turn light beam on. Uses 2 AA and 1 9V battery (not included).

MV-918 $74.95

The **MOVIT** line is a series of computerized (and logic controlled) battery robot kits that can teach the basic principles of robotic sensing and locomotion. Each of the kits features pre-assembled pc boards, hardware and mechanical drive systems that can be handled by anyone. Only basic hand tools are required for assembly. You can experience and learn any one or all of the following features: remote control, sound sensor, infrared sensor, wired control or programmable memory.

You'll want to meet *all* of these entertaining, affordable, robots!

MEDUSA Walking robot with Sound Sensor!



Medusa's electronic brain registers your command and starts to hobble on its 4 legs, stopping after a preset time. Sensor includes condenser microphone Uses 2 N size 1.5 V (E90, MN9100) batteries (not incl.)

MV-939 Sound Sensor $29.95

TERMS: Minimum order $10.00. For shipping and handling, include $2.50 for UPS ground or $3.50 for UPS Blue (air). For each additional air pound, add $1 for UPS Blue shipping and handling. California residents must include 6% sales tax; Bay area and LA residents include 6½% sales tax. Prices are subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturers. All merchandise subject to prior sale.

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STATIC RAMS

2101	256 x 4 (450ns)	1.90
5101	256 x 4 (450ns) (cmos)	3.90
2102-1	1024 x 1 (450ns)	.88
2102L-4	1024 x 1 (450ns) (LP)	.98
2102L-2	1024 x 1 (250ns) (LP)	1.45
2111	256 x 4 (450ns)	2.45
2112	256 x 4 (450ns)	2.95
2114	1024 x 4 (450ns)	.99
2114-25	1024 x 4 (250ns)	1.10
2114L-4	1024 x 4 (450ns) (LP)	1.20
2114L-3	1024 x 4 (300ns) (LP)	1.30
2114L-2	1024 x 4 (200ns) (LP)	1.40
2125	1024 x 1	2.49
2147	4096 x 1 (55ns)	4.90
TMS4044-4	4096 x 1 (450ns)	3.45
TMS4044-3	4096 x 1 (300ns)	3.95
TMS4044-2	4096 x 1 (200ns)	4.45
MK4118	1024 x 8 (250ns)	9.90
TMM2016-200	2048 x 8 (200ns)	4.10
TMM2016-150	2048 x 8 (150ns)	4.90
TMM2016-100	2048 x 8 (100ns)	6.10
HM6116-4	2048 x 8 (200ns) (cmos)	4.70
HM6116-3	2048 x 8 (150ns) (cmos)	4.90
HM6116-2	2048 x 8 (120ns) (cmos)	6.90
HM6116LP-4	2048 x 8 (200ns) (cmos)	6.90
HM6116LP-3	2048 x 8 (150ns) (cmos)(LP)	6.90
HM6116LP-2	2048 x 8 (120ns) (cmos)(LP)	9.95
Z-6132	4096 x 8 (300ns) (Qstat)	33.95
HM6264P-15	8192 x 8 (150ns) (cmos)	38.95
HM6264LP-15	8192 x 8 (150ns) (cmos)	48.95

LP = Low Power   Qstat = Quasi-Static

DYNAMIC RAMS

TMS4027	4096 x 1 (250ns)	1.95
UPD411	4096 x 1 (300ns)	1.95
MM5280	4096 x 1 (300ns)	1.95
MK4108	8192 x 1 (200ns)	1.90
MM5298	8192 x 1 (250ns)	1.80
4116-200	16384 x 1 (200ns)	.79
4116-150	16384 x 1 (150ns)	1.20
2118	16384 x 1 (150ns) (5v)	4.90
4164-250	65536 x 1 (250ns)	4.45
4164-200	65536 x 1 (200ns) (5v)	5.00
4164-150	65536 x 1 (150ns) (5v)	5.00

5V = Single 5 Volt Supply

EPROMS

1702	256 x 8 (1us)	4.45
2708	1024 x 8 (450ns)	2.49
2758	1024 x 8 (450ns) (5v)	5.90
2716	2048 x 8 (450ns) (5v)	2.95
2716-1	2048 x 8 (350ns) (5v)	5.90
TMS2516	2048 x 8 (450ns) (5v)	5.45
TMS2716	2048 x 8 (450ns)	6.95
TMS2532	4096 x 8 (450ns) (5v)	5.90
2732	4096 x 8 (450ns) (5v)	4.45
2732-250	4096 x 8 (250ns) (5v)	6.90
2732-200	4096 x 8 (200ns) (5V)	10.95
2764	8192 x 8 (450ns) (5v)	6.45
2764-250	8192 x 8 (250ns) (5v)	7.45
2764-200	8192 x 1 (200ns) (5v)	18.45
TMS2564	8192 x 8 (450ns) (5v)	16.95
MC68764	8192 x 8 (450ns) (5v) (24 pin)	38.95
27128	16384 x 8 Call	24.95

5v = Single 5 Volt Supply

74LS00

74LS00	.23	74LS125	.48	74LS260	.58
74LS01	.24	74LS126	.48	74LS266	.54
74LS02	.24	74LS132	.58	74LS273	1.45
74LS03	.24	74LS133	.58	74LS275	3.30
74LS04	.23	74LS136	.38	74LS279	.48
74LS05	.24	74LS137	.98	74LS280	1.95
74LS08	.27	74LS138	.54	74LS283	.68
74LS09	.28	74LS139	.54	74LS290	.88
74LS10	.24	74LS145	1.15	74LS293	.88
74LS11	.34	74LS147	2.45	74LS295	.98
74LS12	.34	74LS148	1.30	74LS298	.88
74LS13	.44	74LS151	.54	74LS299	1.70
74LS14	.58	74LS153	.54	74LS323	3.45
74LS15	.34	74LS154	1.65	74LS324	1.70
74LS20	.24	74LS155	.68	74LS352	1.25
74LS21	.28	74LS156	.68	74LS353	1.25
74LS22	.24	74LS157	.64	74LS363	1.30
74LS26	.28	74LS158	.58	74LS364	1.90
74LS27	.28	74LS160	.68	74LS365	.48
74LS28	.34	74LS161	.64	74LS366	.48
74LS30	.24	74LS162	.68	74LS367	.44
74LS32	.28	74LS163	.64	74LS368	.44
74LS33	.54	74LS164	.68	74LS373	1.35
74LS37	.34	74LS165	.94	74LS374	1.35
74LS38	.34	74LS166	1.90	74LS377	1.35
74LS40	.24	74LS168	1.70	74LS378	1.13
74LS42	.48	74LS169	1.70	74LS379	1.30
74LS47	.74	74LS170	1.45	74LS385	1.85
74LS48	.74	74LS173	.68	74LS386	.44
74LS49	.74	74LS174	.54	74LS390	1.15
74LS51	.24	74LS175	.54	74LS393	1.15
74LS54	.28	74LS181	2.10	74LS395	1.15
74LS55	.28	74LS189	8.90	74LS399	1.45
74LS63	1.20	74LS190	.88	74LS424	2.90
74LS73	.38	74LS191	.88	74LS447	.38
74LS74	.34	74LS192	.78	74LS490	1.90
74LS75	.38	74LS193	.78	74LS624	3.95
74LS76	.38	74LS194	.68	74LS640	2.15
74LS78	.48	74LS195	.68	74LS645	2.15
74LS83	.59	74LS196	.78	74LS668	1.65
74LS85	.68	74LS197	.78	74LS669	1.85
74LS86	.38	74LS221	.88	74LS670	1.45
74LS90	.54	74LS240	.94	74LS674	9.60
74LS91	.88	74LS241	.98	74LS682	3.15
74LS92	.54	74LS242	.98	74LS683	3.15
74LS93	.54	74LS243	.98	74LS684	3.15
74LS95	.74	74LS244	1.25	74LS685	3.15
74LS96	.88	74LS245	1.45	74LS688	2.35
74LS107	.38	74LS247	.74	74LS689	3.15
74LS109	.38	74LS248	.98	74LS783	23.95
74LS112	.38	74LS249	.98	81LS95	1.45
74LS113	.38	74LS251	.58	81LS96	1.45
74LS114	.38	74LS253	.58	81LS97	1.45
74LS122	.44	74LS257	.58	81LS98	1.45
74LS123	.78	74LS258	.58	25LS2521	2.75
74LS124	2.85	74LS259	2.70	25LS2569	4.20

CRT CONTROLLERS

1771	14.95	2797	64.65
1791	23.95	6843	33.95
1793	25.95	8272	38.95
1795	28.95	UPD765	38.95
1797	48.95	MB8876	23.95
2791	79.95	MB8877	25.95
2793	79.95	1691	16.95
2795	64.95	2143	17.95

DISC CONTROLLERS

1771	14.95	2797	84.95
1791	23.95	6843	33.95
1793	25.95	8272	38.95
1795	48.95	UPD765	38.95
1797	48.95	MB8876	28.95
2791	79.95	MB8877	33.95
2793	79.95	1691	18.95
2795	84.95	2143	17.95

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6500

1 MHZ		2 MHZ	
6502	4.90	6502A	6.90
6504	6.90	6522A	9.90
6505	6.90	6532A	10.96
6507	9.90	6545A	28.95
6520	4.30	6551A	10.95
6522	6.90	**3 MHZ**	
6532	9.90		
6545	21.50	66026	9.90
6551	10.85		

6800

68000	66.96	6860	9.90
6800	3.90	6862	10.95
6802	7.90	6875	6.90
6808	12.90	6880	2.20
6809E	16.95	6883	21.95
6809	10.95	68047	23.95
6810	2.90	68488	16.95
6820	4.30		
6821	3.20	**1 MHZ**	
6826	13.95	68B00	9.95
6840	11.95	68B02	21.25
6843	33.95	68B09E	28.95
6844	24.95	68B09	26.95
6845	13.95	68B10	6.90
6847	10.96	68B21	6.90
6850	3.20	68B45	16.95
6852	15.70	68B50	5.90

MICROPROCESSORS

8000

8035	5.90	8089	88.96
8039	6.90	8156	6.90
INS-8060	16.95	8156-2	7.90
INS-8073	49.96	8168	8.90
8080	3.90	8185	28.95
8085	5.90	8185-2	38.95
8085A-2	10.95	8741	38.96
8086	28.96	8748	49.95
8087	199.00	8755	23.96
8088	38.96		

8200

8202	23.95	8255-5	5.20
8203	38.95	8257	7.90
8205	3.45	8257-5	8.90
8212	1.75	8259	6.85
8214	3.80	8259-5	7.45
8216	1.70	8271	75.00
8224	2.20	8272	38.95
8226	1.75	8275	28.95
8228	3.45	8279	8.90
8237	16.95	8279-5	9.00
8237-5	20.95	8282	6.45
8238	4.45	8283	8.45
8243	10.95	8284	14.95
8250	16.95	8286	8.45
8251	4.45	8287	6.45
8253	6.90	8288	24.00
8253-5	7.90	8289	48.95
8255	4.45	8292	16.95

Z-80

2.5 .... MHZ		4.0 MHZ	
Z80-CPU	3.90	Z80A-CPU	4.29
Z80-CTC	3.96	Z80A-CTC	4.90
Z80-DART	10.96	Z80A-DART	9.95
Z80-DMA	13.96	Z80A-DMA	12.96
Z80-PIO	3.95	Z80A-PIO	4.29
Z80-SIO/0	11.95	Z80A-SIO/0	12.96
Z80-SIO/1	11.96	Z80A-SIO/1	12.96
Z80-SIO/2	11.95	Z80A-SIO/2	12.95
Z80-SIO/9	11.96	Z80A-SIO/9	12.95

6.0 MHZ		ZILOG	
Z80B-CPU	9.96	Z6132	33.96
Z80B-CTC	12.96	Z8671	38.95
Z80B-PIO	12.96		
Z80B-DART	12.96		

MEMORY EXPANSION KIT



4164 150ns

9 for $45.00

Low Cost EPROM – PROGRAMMER –

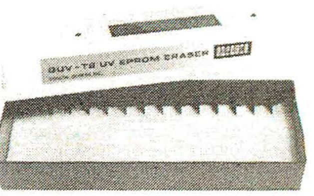


The "Shooter" $395.00

- 32K bits upgradable to 126K memory
- Built-in Serial RS-232 Port
- Program & verify 2716 thru 27256
- Intelligent, fast programming
- Up/download Hex, Binary, ASCII etc.
- Serial RS-232 interface compatible

UV ERASERS

QUV-T8/1 $49.95
ECONOMY Model



- Erases 6 EPROMS in 20 minutes
- Plastic Enclosure

QUV-T8/2T $97.50
INDUSTRIAL Model

- Tray Action, • UV Indicator
- 60-minute adjustable timer
- Steel enclosure • Safety switch
- Erase 15 EPROMS in 20 minutes

QUV-T8/2N $68.95
(No Timer)

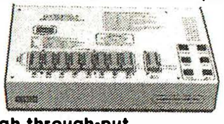
LUV-1 $149.95
PRODUCTION Model

QUV-T8/2 $124.95
FAST Industrial Model

ST-8 $195.00
8-Tray Storage Cabinet

GANG PROGRAMMER

GANGPRO-8™ $995.00



- High through-put
- Reliable, user-friendly
- Intelligent algorithm
- Program and verify 2716 thru 27256
- Stand alone (RS-232 option $165)

OTHER PRODUCTS:

PROMPRO-8 $689.00
64K Version

- Powerful EPROM/Micro development programmer
- Keypad simulation
- 256K memory buffer option available

PROMPRO-7 $489.00

- 32K non-expandable unit
- Built-in 8748, 8749 programming

PALPRO-2 $1895.00
Stand-alone RS-232 Unit

- Programs 20 and 24 series PALs

PALPRO-1 $995.00
Programs 20-pin PALs

LOGICAL DEVICES, INC. LOGICAL

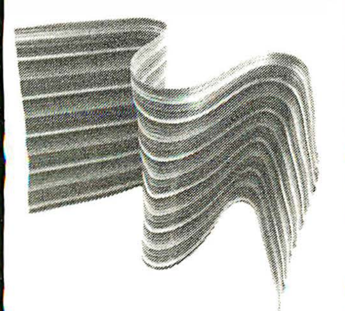
Circle 131 on inquiry card.

DIP SWITCHES



4 POSITION	.84
5 POSITION	.89
6 POSITION	.89
7 POSITION	.94
8 POSITION	.94

RIBBON CABLE



CONTACTS	SINGLE COLOR 1'	SINGLE COLOR 10'	COLOR CODED 1'	COLOR CODED 10''
10	.45	4.30	.78	7.20
16	.50	4.70	.95	8.70
20	.60	5.60	1.15	10.90
25	.70	6.50	1.22	11.50
26	.70	6.50	1.27	11.50
34	.93	8.50	1.55	14.40
40	1.27	11.50	1.82	16.70
50	1.28	12.00	2.40	21.90

IC SOCKETS
(1 to 99)

8 pin ST	.12	8 pin WW	.58
14 pin ST	.14	14 pin WW	.68
16 pin ST	.16	16 pin WW	.68
18 pin ST	.19	18 pin WW	.98
20 pin ST	.28	20 pin WW	1.04
22 pin ST	.29	22 pin WW	1.34
24 pin ST	.29	24 pin WW	1.44
28 pin ST	.39	28 pin WW	1.64
40 pin ST	.48	40 pin WW	1.94

ST = Soldertail WW = Wirewrap

ZIF SOCKETS



16 pin ZIF	5.90
24 pin ZIF	7.90
28 pin ZIF	8.90

ZIF = TEXTOOL (Zero Insertion Force)

VOLTAGE REGULATORS

7805T	.74	7905T	.84
78M05C	.34	7908T	.84
7808T	.74	7912T	.84
7812T	.74	7915T	.84
7815T	.74	7924T	.84
7824T	.74	7905K	1.44
7805K	1.34	7912K	1.44
7812K	1.34	7915K	1.44
781 5K	1.34	7924K	1.44
7824K	1.34	79L05	.78
78L05	.68	79L12	.78
78L12	.68	79L15	.78
78L15	.68	LM323K	4.90
78H05K	9.90	UA78S40	1.90
78H12K	9.90		

C,T = TO-220 K = TO-3
L = TO-92

CRYSTALS

1.0000 MHz	3.89	8.0000 MHz	2.89
1.8432 MHz	3.89	10.0000 MHz	2.89
2.0000 MHz	2.89	10.7386 MHz	2.89
2.0972 MHz	2.69	12.0000 MHz	2.69
2.4576 MHz	2.89	14.3182 MHz	2.69
3.2768 MHz	2.89	15.0000 MHz	2.89
3.5795 MHz	2.89	16.0000 MHz	2.89
4.0000 MHz	2.89	17.4300 MHz	2.89
4.1943 MHz	2.89	18.0000 MHz	2.89
4.9160 MHz	2.89	18.4320 MHz	2.69
5.0000 MHz	2.89	19.6608 MHz	2.89
5.0688 MHz	2.69	20.0000 MHz	2.89
5.1850 MHz	2.69	22.1184 MHz	2.89
5.2429 MHz	2.89	32.0000 MHz	2.89
5.7143 MHz	2.69	36.0000 MHz	2.89
6.0000 MHz	2.89	48.0000 MHz	2.89
6.1440 MHz	2.69	49.4350 MHz	2.89
6.4000 MHz	2.69	49.8900 MHz	2.89
6.5536 MHz	2.89		

32.768 KHz...... 1.69

CRYSTAL CLOCK OSCILLATORS

PART NO.	FREQUENCY	PRICE
1.000	1.0000 MHz	9.95
1.843	1.8432 MHz	9.95
2.000	2.0000 MHz	9.95
4.000	4.0000 MHz	9.95
6.000	6.0000 MHz	9.95
10.000	10.0000 MHz	9.95
16.000	16.0000 MHz	9.95
18.432	18.4320 MHz	9.95
19.660	19.6608 MHz	9.95
20.000	20.0000 MHz	9.95
32.000	32.0000 MHz	9.95

EDGECARD CONECTORS

S-100 ST	3.85	50-pin ST	4.85
S-100WW	4.85	44-pin ST	2.85
72-pin ST	8.85		
72-pinWW	7.85	44-pinWW	4.85

RESISTORS

¼ WATT 5% CARBON FILM
ALL STANDARD VALUES
FROM 1 OHM - 10 MEG OHM

50 PCS	1.25
100 PCS	2.00
1,000 PCS	15.00

LED LAMPS



	1-99	100+
Jumbo RED	.09	.08
Jumbo GREEN	.16	.14
Jumbo YELLOW	.16	.14

INTERFACE CHIPS

8T26	1.54	8T98	.88
8T28	1.64	DM8131	2.90
8T95	.88	DP8304	2.24
8T96	.88	DS8835	1.94
8T97	.88	DS8836	.98

— TRANSISTORS —

2N918	.49	2N3563	.39	2N4402	.24
MPS918	.24	2N3565	.39	2N4403	.24
2N2102	.74	PN3565	.24	2N4857	.99
2N2218	.49	MPS3638	.24	PN4916	.24
2N2218A	.49	MPS3640	.24	2N5088	.24
2N2219	.49	PN3643	.24	PN5129	.24
2N2219A	.49	PN3644	.24	PN5139	.24
2N2222	.24	MPS3704	.14	2N5209	.24
PN2222	.09	MPS3706	.14	2N6028	.34
MPS2369	.24	2N3772	1.60	2N6043	1.70
2N2484	.24	2N3903	.24	2N6045	1.70
2N2905	.49	2N3904	.09	MPS-A05	.24
2N2907	.24	2N3906	.09	MPS-A06	.24
PN2907	1.20	2N4122	.24	MPS-A55	.24
2N3055	.78	2N4123	.24	TIP29	.64
3055T	.88	2N4249	.24	TIP31	.74
2N3393	.29	2N4304	.74	TIP32	.78
2N3414	.24	2N4401	.24		

DIP CONNECTORS

DESCRIPTION	ORDER BY	8	14	16	18	20	22	24	28	40
HIGH RELIABILITY TOOLED ST IC SOCKETS	HRTxxST	.94	.94	.94	1.59	1.79	1.79	1.89	2.39	2.89
COMPONENT CARRIERS (DIP HEADERS)	ICCxx	.60	.70	.80	.95	1.15	1.15	1.25	1.40	2.00
RIBBON CABLE DIP PLUGS (IDC)	IDPxx	—	1.35	1.55	—	—	—	2.40	—	4.05

ORDER EXAMPLE: A 14-pin High Rel. ST socket would be HRT 14 ST

D-SUBMINIATURE

DESCRIPTION		ORDER BY	9	15	25	37	50
SOLDER CUP	MALE	DPxxP	1.98	2.59	2.40	4.70	5.96
SOLDER CUP	FEMALE	DBxxS	2.56	3.53	3.15	7.01	9.14
RT. ANGLE PC. SOLDER	MALE	DBxxPR	1.55	2.10	2.90	4.73	—
RT. ANGLE PC. SOLDER	FEMALE	DBxxSR	2.08	2.93	4.32	6.09	—
IDC RIBBON CABLE	MALE	IDPxxP	3.27	4.60	6.13	9.12	—
IDC RIBBON CABLE	FEMALE	IDBxxS	3.59	5.03	6.74	9.98	—
HOODS	BLACK	HOOD-B	—	—	1.15	—	—
HOODS	GREY	HOOD	1.50	1.50	1.15	2.85	3.40

ORDER EXAMPLE: A 5-pin Male Solder Cup would be MALE DP 25 P

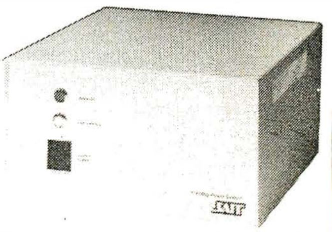
IDC CONNECTORS

DESCRIPTION	ORDER BY	10	20	26	34	40	50
SOLDER HEADER	IDHxxS	.77	1.19	1.58	2.10	2.48	3.14
RT. ANGLE SOLDER HEADER	IDHxxSR	.80	1.25	1.88	2.21	2.62	3.29
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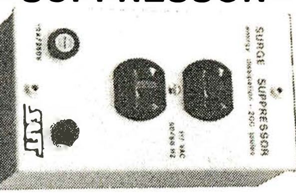
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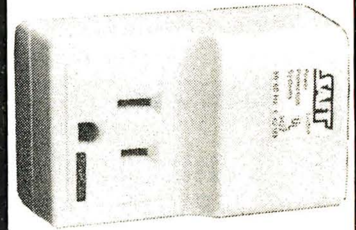
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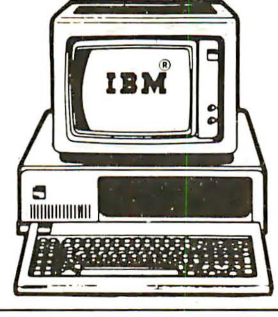
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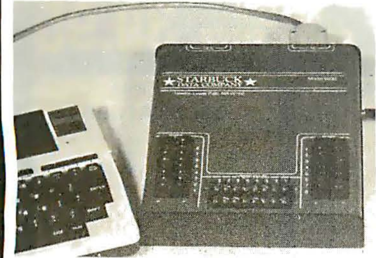
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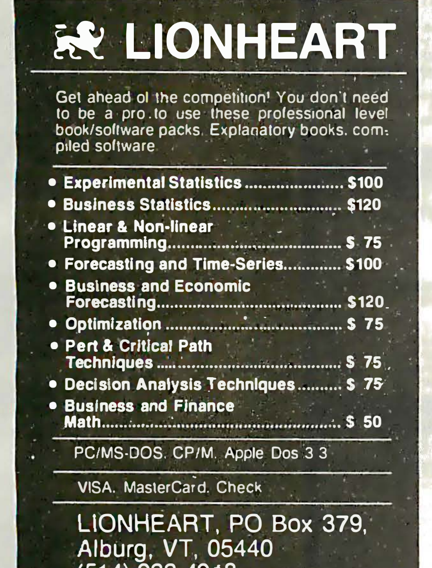
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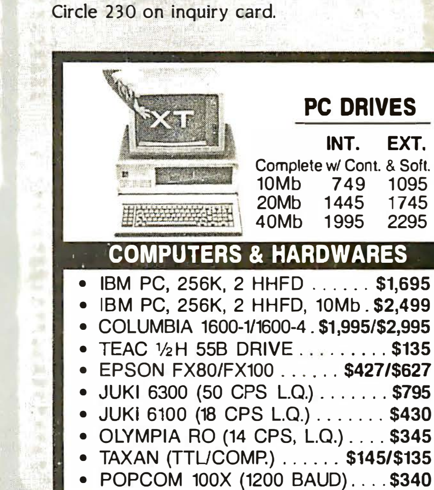
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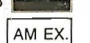
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MK4108	8192x1	(200ns)	1.95
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4116-300	16384x1	(300ns)	8/11.75
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5v=Single 5 Volt Supply REFRESH=Pin 1 Refresh

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2764	8192x8	(450ns)(5V)	6.95
2764-250	8192x8	(250ns)(5V)	7.95
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5V=Single 5 Volt Supply 21V PGM=Program at 21 Volts

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74LS21	.29	74LS245	1.49
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74LS26	.29	74LS248	.99
74LS27	.29	74LS249	.99
74LS28	.35	74LS251	.59
74LS30	.25	74LS253	.59
74LS32	.29	74LS257	.59
74LS33	.55	74LS258	.59
74LS37	.35	74LS259	2.75
74LS38	.35	74LS260	.59
74LS40	.25	74LS261	2.25
74LS42	.49	74LS266	.55
74LS47	.75	74LS273	1.49
74LS48	.75	74LS275	3.35
74LS49	.75	74LS279	.49
74LS51	.25	74LS280	1.98
74LS54	.29	74LS283	.69
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74LS169	1.75	25LS2518	4.13
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74LS174	.55	25LS2569	2.80
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7405	.29	7491	.40	74177	.75
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7408	.24	7494	.65	74180	.75
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7421	.35	74116	1.55	74194	.85
7422	.35	74120	1.20	74195	.85
7423	.29	74121	.29	74196	.79
7425	.29	74122	.45	74197	.75
7426	.29	74123	.49	74198	1.35
7427	.29	74125	.45	74199	1.35
7428	.45	74126	.45	74221	1.35
7430	.19	74128	.55	74246	1.35
7432	.29	74132	.45	74247	1.25
7433	.45	74136	.50	74248	1.85
7437	.29	74141	.65	74249	1.95
7438	.29	74142	2.95	74251	.75
7439	.79	74143	4.95	74259	2.25
7440	.19	74144	2.95	74265	1.35
7442	.49	74145	.60	74273	1.95
7443	.65	74147	1.75	74276	1.25
7444	.69	74148	1.20	74278	3.11
7445	.69	74150	1.35	74279	.75
7446	.69	74151	.55	74283	2.00
7447	.69	74152	.65	74284	3.75
7448	.69	74153	.55	74285	3.75
7450	.19	74154	1.25	74290	.95
7451	.23	74155	.75	74293	.75
7453	.23	74156	.65	74298	.85
7454	.23	74157	.55	74351	2.25
7460	.23	74159	1.65	74365	.65
7470	.35	74160	.85	74366	.65
7472	.29	74161	.69	74367	.65
7473	.34	74162	.85	74368	.65
7474	.33	74163	.69	74376	2.20
7475	.45	74164	.85	74390	1.75
7476	.35	74165	.85	74393	1.35
7480	.59	74166	1.00	74425	3.15
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4012	.25	4560	4.25
4013	.38	4569	3.49
4014	.79	4581	1.95
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4018	.79	45151	12.95
4019	.39	4702	12.95
4020	.75	4724	1.50
4021	.79	74C00	.35
4022	.79	74C02	.35
4023	.29	74C04	.35
4024	.65	74C08	.35
4025	.29	74C10	.35
4026	1.65	74C14	.59
4027	.45	74C20	.35
4028	.69	74C30	.35
4029	.79	74C32	.39
4030	.39	74C42	1.29
4034	1.95	74C48	1.99
4035	.85	74C73	.65
4040	.75	74C74	.65
4041	.75	74C76	.80
4042	.69	74C83	1.95
4043	.85	74C85	1.95
4044	.79	74C86	.39
4046	.85	74C89	4.50
4047	.95	74C90	1.19
4048	.69	74C93	1.75
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4050	.35	74C150	5.75
4051	.79	74C151	2.25
4052	1.99	74C154	3.25
4053	.79	74C157	1.75
4060	.89	74C160	1.19
4066	.39	74C161	1.19
4068	.39	74C162	1.19
4069	.29	74C163	1.19
4070	.35	74C164	1.39
4071	.29	74C165	2.00
4072	.29	74C173	.79
4073	.29	74C174	1.19
4075	.29	74C175	1.19
4076	.79	74C192	1.49
4077	.59	74C193	1.49
4078	.29	74C195	1.39
4081	.29	74C200	5.75
4082	.29	74C221	1.75
4085	.95	74C224	2.25
4086	.95	74C373	2.45
4093	.49	74C374	2.45
4094	2.99	74C901	.39
4098	2.49	74C902	.85
4099	1.95	74C903	.85
14409	12.95	74C905	10.95
14410	12.95	74C906	.95
14411	11.95	74C907	1.00
14412	12.95	74C908	2.00
14419	7.95	74C909	2.75
14433	14.95	74C910	9.95
4502	.95	74C911	8.95
4503	.65	74C912	8.95
4507	1.25	74C914	1.95
4508	1.95	74C915	1.19
4510	.85	74C918	2.75
4511	.85	74C920	17.95
4512	.85	74C921	15.95
4514	1.25	74C922	4.49
4515	1.79	74C923	4.95
4516	1.55	74C925	5.95
4518	.89	74C926	7.95
4519	.39	74C927	7.95
4520	.79	74C928	7.95
4521	4.99	74C929	19.95
4522	1.25	74C930	4.95
4526	1.25	80C95	.85
4527	1.95	80C96	.95
4528	1.19	80C97	.95
4529	2.95	80C98	1.20
4531	.95		

HIGH SPEED CMOS

A new family of high speed CMOS logic featuring the speed of low power Schottky (8ns typical gate propagation delay), combined with the advantages of CMOS: very low power consumption, superior noise immunity, and improved output drive.

74HC00

74HC: Operate at CMOS logic levels and are ideal for new, all-CMOS designs.

74HC00	.59	74HC175	.99
74HC02	.59	74HC193	1.25
74HC04	.59	74HC194	1.04
74HC08	.59	74HC195	1.09
74HC10	.59	74HC238	1.35
74HC11	.59	74HC240	1.89
74HC14	.79	74HC241	1.89
74HC20	.59	74HC242	1.89
74HC27	.59	74HC243	1.89
74HC30	.59	74HC244	1.89
74HC32	.69	74HC245	1.89
74HC51	.59	74HC251	.89
74HC74	.75	74HC257	.85
74HC75	.85	74HC259	1.39
74HC85	1.35	74HC273	1.89
74HC86	.69	74HC299	4.99
74HC93	1.19	74HC367	.99
74HC125	1.19	74HC373	2.29
74HC132	1.19	74HC374	2.29
74HC138	.99	74HC393	1.39
74HC139	.99	74HC4017	1.99
74HC151	.89	74HC4020	1.39
74HC153	.89	74HC4024	1.59
74HC154	2.49	74HC4040	1.39
74HC157	.89	74HC4049	.89
74HC161	1.15	74HC4050	.89
74HC164	1.25	74HC4060	1.29
74HC166	2.95	74HC4511	2.39
74HC174	.99	74HC4538	2.29

74HCT00

74HCT: Direct, drop-in replacements for LS TTL and can be intermixed with 74LS in the same circuit.

74HCT00	.69	74HCT175	1.09
74HCT02	.69	74HCT193	1.39
74HCT04	.69	74HCT194	1.19
74HCT08	.69	74HCT195	1.29
74HCT10	.69	74HCT238	1.49
74HCT11	.69	74HCT240	2.19
74HCT14	.89	74HCT241	2.19
74HCT20	.69	74HCT242	2.19
74HCT27	.69	74HCT243	2.19
74HCT30	.69	74HCT244	2.19
74HCT32	.79	74HCT245	2.19
74HCT51	.69	74HCT251	1.09
74HCT74	.85	74HCT257	.99
74HCT75	.95	74HCT259	1.59
74HCT85	1.49	74HCT273	2.09
74HCT86	.79	74HCT299	5.25
74HCT93	1.29	74HCT367	1.09
74HCT125	1.29	74HCT373	2.49
74HCT132	1.29	74HCT374	2.49
74HCT138	1.15	74HCT393	1.59
74HCT139	1.15	74HCT4017	2.19
74HCT151	1.05	74HCT4020	1.59
74HCT153	1.05	74HCT4024	1.79
74HCT154	2.99	74HCT4040	1.59
74HCT157	.99	74HCT4049	.99
74HCT161	1.29	74HCT4050	.99
74HCT164	1.39	74HCT4060	1.49
74HCT166	3.05	74HCT4511	2.69
74HCT174	1.09	74HCT4538	2.59

SPECTRONICS CORPORATION

EPROM ERASERS

	Timer	Capacity Chip	Intensity (uW/Cm²)	
PE-14		9	8,000	$83.00
PE-14T	x	9	8,000	$119.00
PE-24T	x	12	9,600	$175.00
PL-265T	x	30	9,600	$255.00
PR-125T	x	25	17,000	$349.00
PR-320T	x	42	17,000	$595.00

VOLTAGE REGULATORS

TO-220 CASE PACKAGE

7805T	.75	7905T	.85
7808T	.75	7908T	.85
7812T	.75	7912T	.85
7815T	.75	7915T	.85
7824T	.75	7924T	.85

TO-3 CASE PACKAGE

7805K	1.39	7905K	1.49
7812K	1.39	7912K	1.49
7815K	1.39	7915K	1.49
7824K	1.39	7924K	1.49

TO-92 CASE PACKAGE

78L05	.69	79L05	.79
78L12	.69	79L12	.79
78L15	.69	79L15	.79

OTHER VOLTAGE REGS

78M05C	5volt	½amp	TO-220	.35
LM323K	5volt	3amp	TO-3	4.95
LM338K	Adj.	5amp	TO-3	3.95
78H05K	5volt	5amp	TO-3	9.95
78H12K	12volt	5amp	TO-3	9.95
78P05K	5volt	10amp	TO-3	14.95
UA78S40	FAIRCHILD		DIP	1.95

LINEAR

LM301	.34	LM567	.89
LM301H	.79	NE570	3.95
LM307	.45	NE571	2.95
LM308	.69	NE590	2.50
LM308H	1.15	NE592	.98
LM309H	1.95	LM709	.59
LM309K	1.25	LM710	.75
LM310	1.75	LM711	.79
LM311	.64	LM723	.49
LM311H	.89	LM723H	.55
LM312H	1.75	LM733	.98
LM317K	3.95	LM741	.35
LM317T	1.19	LM741N-14	.35
LM318	1.49	LM741H	.40
LM318H	1.59	LM747	.69
LM319H	1.90	LM748	.59
LM319	1.25	LM1014	1.19
LM320	see 7900	LM1303	1.95
LM322	1.65	LM1310	1.49
LM323K	4.95	MC1330	1.69
LM324	.59	MC1349	1.89
LM329	.65	MC1350	1.19
LM331	3.95	MC1358	1.69
LM334	1.19	MC1372	6.95
LM335	1.40	LM1414	1.59
LM336	1.75	LM1458	.59
LM337T	1.95	LM1488	.69
LM337K	3.95	LM1489	.69
LM338K	3.95	LM1496	.85
LM339	.99	LM1558H	3.10
LM340	see 7800	LM1800	2.37
LM348K	.99	LM1812	8.25
LM350K	4.95	LM1830	3.50
LM350T	4.60	LM1871	5.49
LM358	.69	LM1872	5.49
LM359	1.79	LM1877	3.52
LM376	3.75	LM1889	1.95
LM377	1.95	LM1896	1.75
LM378	2.50	ULN2003	2.49
LM379	4.50	LM2877	2.05
LM380	.89	LM2878	2.25
LM380N-8	1.10	LM2900	.85
LM381	1.60	LM2901	1.00
LM382	1.60	MPQ2907	1.95
LM383	1.95	LM2917	2.95
LM384	1.95	LM3900	.59
LM386	.89	LM3905	1.25
LM387	1.40	LM3909	.98
LM389	1.35	LM3911	2.25
LM390	1.95	LM3914	3.95
LM392	.69	LM3915	3.95
LM393	1.29	LM3916	3.95
LM394H	4.60	MC4024	3.95
LM399H	5.00	MC4044	4.50
NE531	2.95	RC4136	1.25
NE555	.34	RC4151	3.95
NE556	.65	LM4250	1.75
NE558	1.50	LM4500	3.25
NE564	2.95	RC4558	.69
LM565	.99	LM13600	1.49
LM566	1.49	LM13700	1.45

H=TO-5 CAN, K=TO-3, T=TO-220

RCA

CA3023	2.75	CA3083	1.55
CA3039	1.29	CA3086	.80
CA3046	1.25	CA3089	2.99
CA3059	2.90	CA3096	3.49
CA3060	2.90	CA3130	1.30
CA3065	1.75	CA3140	1.15
CA3080	1.10	CA3146	1.85
CA3081	1.65	CA3160	1.19
CA3082	1.65	CA3183	.99

TI

TL494	4.20	75365	1.95
TL496	1.65	75450	.59
TL497	3.25	75451	.39
75107	1.49	75452	.39
75108	1.49	75453	.39
75110	1.95	75454	.39
75150	1.95	75491	.79
75154	1.95	75492	.79
75188	1.25	75493	.89
75189	1.25	75494	.89

BI FET

TL066	.99	LF347	2.19
TL071	.79	LF351	.60
TL072	1.19	LF353	1.00
TL074	2.19	LF355	1.10
TL081	.79	LF356	1.10
TL082	1.19	LF357	1.40
TL083	1.19	LF411	1.29
TL084	2.19	LF412	1.99

TRANSISTORS

2N918	.50	2N3772	1.85
MPS918	.25	2N3903	.25
2N2102	.75	2N3904	.10
2N2218	.50	2N3906	.10
2N2218A	.50	2N4122	.25
2N2219	.50	2N4123	.25
2N2219A	.50	2N4249	.25
2N2222	.25	2N4304	.75
PN2222	.10	2N4401	.25
MPS2369	.25	2N4402	.25
2N2484	.25	2N4403	.25
2N2905	.50	2N4857	1.00
2N2907	.25	PN4916	.25
PN2907	1.25	2N5086	.25
2N3055	.79	PN5129	.25
3055T	.69	PN5139	.25
2N3393	.30	2N5209	.25
2N3414	.25	2N6028	.35
2N3563	.40	2N6043	1.75
2N3565	.40	2N6045	1.75
PN3565	.25	MPS-A05	.25
MPS3638	.25	MPS-A06	.25
MPS3640	.25	MPS-A13	.40
PN3643	.25	MPS-A55	.25
PN3644	.25	MPU-131	.99
MPS3704	.15	TIP29	.65
MPS3706	.15	TIP31	.75
		TIP32	.79

IC SOCKETS

	1-99	100
8 PIN ST	.13	.11
14 PIN ST	.15	.12
16 PIN ST	.17	.13
18 PIN ST	.20	.18
20 PIN ST	.29	.27
22 PIN ST	.30	.27
24 PIN ST	.30	.27
28 PIN ST	.40	.32
40 PIN ST	.49	.39
64 PIN ST	4.25	CALL

ST=SOLDERTAIL

	1-99	100
8 PIN WW	.59	.49
14 PIN WW	.69	.52
16 PIN WW	.69	.58
18 PIN WW	.99	.90
20 PIN WW	1.09	.98
22 PIN WW	1.39	1.28
24 PIN WW	1.49	1.35
28 PIN WW	1.69	1.49
40 PIN WW	1.99	1.80

WW=WIREWRAP

INTERFACE

8T26	1.59
8T28	1.98
8T95	.89
8T96	.89
8T97	.89
8T98	.89
DM8131	2.95
DP8304	2.29
DS8833	2.25
DS8835	1.99
DS8836	.99
DS8837	1.65
DS8838	1.30

INTERSIL

ICL7106	9.95
ICL7107	12.95
ICL7660	2.95
ICL8038	3.95
ICM7207A	5.59
ICM7208	15.95

DATA AQC

ADC0800	15.55
ADC0804	3.49
ADC0809	4.49
ADC0816	14.95
ADC0817	9.95
ADC0831	8.95
DAC0800	4.49
DAC0806	1.95
DAC0808	2.95
DAC1020	8.25
DAC1021	7.95
DAC1022	5.95
MC1408L6	1.95
MC1408L8	2.95

EXAR

XR2206	3.75
XR2207	3.75
XR2208	3.75
XR2211	5.25
XR2240	3.25

9000

9304	.95
9316	1.00
9328	1.49
9334	2.50
9368	3.95
9401	9.95
9601	.75
9602	1.50
9637	2.95
96S02	1.95

SOUND CHIPS

76477	3.95
76488	5.95
76489	8.95
SSI-263	39.95
AY3-8910	12.95
AY3-8912	12.95
MC3340	1.49
SP1000	39.00

OPTO-ISOLATORS

4N26	1.00	MCA-7	4.25
4N27	1.10	MCA-225	1.75
4N28	.69	IL-1	1.25
4N33	1.75	ILA-30	1.25
4N35	1.25	ILQ-74	2.75
4N37	1.25	H11C5	1.25
MCT-2	1.00	TIL-111	1.00
MCT-6	1.50	TIL-113	1.75

Your friends at JDR would like to wish you and your family a pleasant holiday season, and a prosperous New Year.

VISA MasterCard

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Circle 209 on inquiry card.

27128 16Kx8 EPROM 250ns 24.95

4116 16K DYNAMIC 250ns 8/7.95

BARGAIN HUNTERS CORNER

2 LEVEL WIRE WRAP SOCKETS

THESE SOCKETS HAVE .50" LEADS. JUST A LITTLE SHORTER THAN THAN THE STANDARD 3 LEVEL WIRE WRAP SOCKETS WITH .67" LEADS.

	1-99	100-UP
8 PIN WW-2	.40	.35
14 PIN WW-2	.45	.39
16 PIN WW-2	.45	.39
20 PIN WW-2	.75	.59
22 PIN WW-2	.50	.39
24 PIN WW-2	.89	.75
28 PIN WW-2	.89	.75
40 PIN WW-2	.99	.89

SPECIALS END 1/31/85

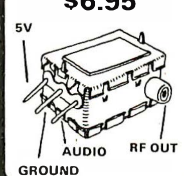
RF MODULATOR

(ASTEC UM1082)

QUANTITIES LIMITED

- PRESET TO CHANNEL 3
- USE TO BUILD TV-COMPUTER INTERFACE
- +5 VOLT OPERATION

$6.95



EMI FILTER

- MFG BY CORONA
- LOW COST
- FITS LC-HP BELOW

$4.95

LINE CORDS

LC-2	2 CONDUCTOR	6 ft	.39
LC-3	3 CONDUCTOR	6 ft	.99
LC-HP	3 CONDUCTOR WITH STANDARD FEMALE SOCKET	6 ft	1.49
LC-CIR	CIGARETTE LIGHTER PLUG WITH 6 ft COILED CORD		2.95

MUFFIN FANS

4.68" SQUARE	14.95
3.125" SQUARE	14.95

CAPACITORS

TANTALUM

1.0µf	15V	.40	.47µf	35V	.50
6.8	15V	.70	1.0	35V	.45
10	15V	.80	2.2	35V	.65
22	15V	1.35	4.7	35V	.85
.22	35V	.40	10	35V	1.00

DISC

10pf	50V	.05	560	50V	.05
22	50V	.05	680	50V	.05
25	50V	.05	820	50V	.05
27	50V	.05	.001µf	50V	.05
33	50V	.05	.0015	50V	.05
47	50V	.05	.0022	50V	.05
56	50V	.05	.005	50V	.05
68	50V	.05	.01	50V	.07
82	50V	.05	.02	50V	.07
100	50V	.05	.05	50V	.07
220	50V	.05	.1	12V	.10

MONOLITHIC

.01µf	50V	.14	.1µf	50V	.18
.047µf	50V	.15	.47µf	50V	.25

ELECTROLYTIC

RADIAL			AXIAL		
1µf	25V	.14	1µf	50V	.14
2.2	35V	.15	4.7	16V	.14
4.7	50V	.15	10	16V	.14
10	50V	.15	10	50V	.16
47	35V	.18	22	16V	.14
100	16V	.18	47	50V	.20
220	35V	.20	100	15V	.20
470	25V	.30	100	35V	.25
2200	16V	.60	220	25V	.30
			330	16V	.40
			550	16V	.42
			1000	16V	.60
			2200	16V	.70
			6000	16V	.85

COMPUTER GRADE

44,000µf 30V 3.95

RESISTORS

¼ WATT 5% CARBON FILM
ALL STANDARD VALUES
FROM 1 OHM TO 10 MEG OHM

50 PIECES SAME VALUE	.025
100 PIECES SAME VALUE	.02
1000 PIECES SAME VALUE	.015

HARD TO FIND "SNAPABLE" HEADERS

Can easily be snapped apart to make any size header, all with .1" centers

1x36	STRAIGHT LEAD	.99
2x40	STRAIGHT LEAD	2.49
2x40	RIGHT ANGLE	2.99

SHORTING BLOCKS

SPACED AT .1" CENTERS
IDEAL FOR DISK DRIVES
OR ANY .1" HEADER

5/1.00

DIP SWITCHES

4 POSITION	.85
5 POSITION	.90
6 POSITION	.90
7 POSITION	.95
8 POSITION	.95
10 POSITION	1.29

EDGECARD CONNECTORS

S-100 ST	3.95
S-100 WW	4.95
72 PIN ST	6.95
72 PIN WW	7.95
62 PIN ST	4.95
50 PIN ST	4.95
44 PIN ST	2.95
44 PIN WW	4.95

BYPASS CAPS

.01µf DISC	100/$6.00
.01µf MONOLITHIC	100/$12.00
.1µf DISC	100/$8.00
.1µf MONOLITHIC	100/$15.00

DIODES

1N751	5.1 VOLT ZENER	.25
1N759	12.0 VOLT ZENER	.25
1N4148	(1N914)SWITCHING	25/1.00
1N4001	50PIV 1A	12/1.00
1N4004	400PIV RECTIFIER	10/1.00
1N5402	200PIV 3A	.25
KBP02	200PIV 1.5A BRIDGE	.45
KBP04	400PIV 1.5A BRIDGE	.55
MDA801	50PIV 12A BRIDGE	1.39
MDA980-1	50PIV 12A BRIDGE	1.95
MDA980-2	100PIV 12A BRIDGE	2.25
VM48	DIP-BRIDGE	.35

36 PIN CENTRONICS

IDCEN36	RIBBON CABLE MALE	8.95
IDCEN36/F	RIBBON CABLE FEMALE	8.95
CEN36	SOLDER CUP MALE	7.95

LED DISPLAYS

HP5082-7760	CC	.43"	1.29
MAN-72	CA	.3"	.99
MAN-74	CC	.3"	.99
FND-537(359)	CC	.375"	1.25
FND-500(503)	CC	.5"	1.49
FND-507(510)	CA	.5"	1.49
TIL-311 4x7 HEX W/LOGIC		.270"	9.95

DIP CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS 8	14	16	18	20	22	24	28	40
HIGH RELIABILITY TOOLED ST IC SOCKETS	AUGATxxST	.99	.99	.99	1.69	1.89	1.89	1.99	2.49	2.99
HIGH RELIABILITY TOOLED WW IC SOCKETS	AUGATxxWW	1.30	1.80	2.10	2.40	2.50	2.90	3.15	3.70	5.40
COMPONENT CARRIES (DIP HEADERS)	ICCxx	.65	.75	.85	1.00	1.25	1.25	1.35	1.50	2.10
RIBBON CABLE DIP PLUGS (IDC)	IDPxx	---	1.45	1.65	---	---	---	2.50	---	4.15

FOR ORDERING INSTRUCTIONS SEE IDC CONNECTORS BELOW

HEAT SINKS

TO-220	SCREW ON	.35
TO-220	CLIP ON	.35
TD-3	SCREW ON	.95
TO-220	INSULATOR	10/1.00
TO-3	INSULATOR	10/1.00

SWITCHES

SPDT	MINI-TOGGLE ON-ON	1.25
DPDT	MINI-TOGGLE ON-ON	1.50
DPDT	MINI-TOGGLE ON-OFF-ON	1.75
SPST	MINI-PUSHBUTTON N.O.	.39
SPST	MINI-PUSHBUTTON N.C.	.39
BCD OUT	10 POSITION 6 PIN DIP	1.95

DIFFUSED LEDS

		1-99	100-up
JUMBO RED	T1¾	.10	.09
JUMBO GREEN	T1¾	.10	.09
JUMBO YELLOW	T1¾	.18	.15
MOUNTING HDW	T1¾	.10	.09
MINI RED	T1	.10	.09
MINI GREEN	T1	.18	.15
MINI YELLOW	T1	.18	.15
RECT RED	2x5mm	.25	.22
RECT GREEN	2x5mm	.30	.27
RECT YELLOW	2x5mm	.30	.27

D-SUBMINIATURE

DESCRIPTION		ORDER BY	CONTACTS 9	15	25	37	50
SOLDER CUP	MALE	DBxxP	2.08	2.69	2.50	4.80	6.06
	FEMALE	DBxxS	2.66	3.63	3.25	7.11	9.24
RIGHTANGLE PC SOLDER	MALE	DBxxPR	1.65	2.20	3.00	4.83	---
	FEMALE	DBxxSR	2.18	3.03	4.42	6.19	---
WIRE WRAP	MALE	DBxxPWW	1.69	2.56	3.89	5.60	---
	FEMALE	DBxxSWW	2.76	4.27	6.84	9.95	---
IDC RIBBON CABLE	MALE	IDBxxP	3.37	4.70	6.23	9.22	---
	FEMALE	IDBxxS	3.69	5.13	6.84	10.08	---
HOODS	BLACK	HOOD-B	---	---	1.25	---	---
	GREY	HOOD	1.60	1.60	1.25	2.95	3.50



IDB37S

DB37S

MOUNTING HARDWARE-$1.00

FOR ORDERING INSTRUCTIONS SEE IDC CONNECTORS BELOW

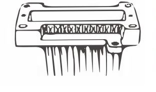
TEXTOOL ZERO INSERTION FORCE SOCKETS AND RECEPTICLES



SCREWDRIVER CLAMP ECONO ZIF



LEVER CLAMP ZIF SOCKET



WW RECEPTICLES ZIF RECEPTICLE

TYPE	CONTACTS 14	16	24	28	40
ECONO ZIF	---	4.95	6.75	7.75	9.95
ZIF SOCKET	5.95	5.95	7.95	8.95	10.95
ZIF RECEPTICLE	8.25	8.75	9.75	10.50	12.75

IDC CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS 10	20	26	34	40	50
SOLDER HEADER	IDHxxS	.82	1.29	1.68	2.20	2.58	3.24
RIGHT ANGLE SOLDER HEADER	IDHxxSR	.85	1.35	1.76	2.31	2.72	3.39
WW HEADER	IDHxxW	1.86	2.98	3.84	4.50	5.28	6.63
RIGHT ANGLE WW HEADER	IDHxxWR	2.05	3.28	4.22	4.45	4.80	7.30
RIBBON HEADER SOCKET	IDSxx	1.15	1.86	2.43	3.15	3.73	4.65
RIBBON HEADER	IDMxx	---	5.50	6.25	7.00	7.50	8.50
RIBBON EDGE CARD	IDExx	2.25	2.36	2.65	3.25	3.80	4.74

IDH20WR

IDE50

ORDERING INSTUCTIONS: INSERT THE NUMBER OF CONTACTS IN THE POSITION MARKED "xx" OF THE "ORDER BY" PART NUMBER LISTED. EXAMPLE: A 10 PIN RIGHT ANGLE HOLDER STYLE WOULD BE IDH10SR

RIBBON CABLE

CONTACTS	SINGLE COLOR 1'	SINGLE COLOR 10'	COLOR CODED 1'	COLOR CODED 10'
10	.50	4.40	.83	7.30
16	.55	4.80	1.00	8.80
20	.65	5.70	1.25	11.00
25	.75	6.60	1.32	11.60
26	.75	6.60	1.32	11.60
34	.98	8.60	1.65	14.50
40	1.32	11.60	1.92	16.80
50	1.38	12.10	2.50	22.00

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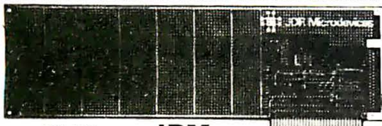
Circle 210 on inquiry card.

HM6116-4 2Kx8 STATIC cmos 200ns 4.75

2732 4Kx8 EPROM 450ns 4.95

WIRE WRAP PROTOTYPE CARDS

FR-4 EPOXY GLASS LAMINATE WITH GOLD-PLATED EDGE-CARD FINGERS



IBM-PR2

IBM

BOTH CARDS HAVE SILK SCREENED LEDGENDS AND INCLUDES MOUNTING BRACKET

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P100-2	HORIZONTAL BUS	$21.80
P100-3	VERTICAL BUS	$21.80
P100-4	SINGLE FOIL PADS PER HOLE	$22.75

APPLE

P500-1	BARE - NO FOIL PADS	$15.15
P500-3	HORIZONTAL BUS	$22.75
P500-4	SINGLE FOIL PADS PER HOLE	$21.80
7060-45	FOR APPLE IIe AUX SLOT	$30.00

GENERAL PURPOSE

22/44 PIN EDGE-CARD (.156" SPACING)

P441-1	BARE - NO FOIL PADS 4.5" x 6.0"	$9.45
P441-3	VERTICAL BUS 4.5" x 6.0"	$13.95
P441-4	SINGLE FOIL PADS 4.5" x 6.0"	$14.20
P442-1	BARE - NO FOIL PADS 4.5" x 9.0"	$10.40
P442-3	VERTICAL BUS 4.5" x 9.0"	$14.20
P442-4	SINGLE FOIL PADS 4.5" x 9.0"	$13.50

36/72 PIN EDGE-CARD (.1" SPACING)

P721-1	BARE - NO FOIL PADS 4.5" x 6.0"	$9.45
P721-3	VERTICAL BUS 4.5" x 6.0"	$13.25
P721-4	SINGLE FOIL PADS 4.5" x 6.0"	$14.20
P722-1	BARE - NO FOIL PADS 4.5" x 9.0"	$10.40
P722-3	VERTICAL BUS 4.5" x 9.0"	$14.20
P722-4	SINGLE FOIL PADS 4.5" x 9.0"	$15.15

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P45x65	4.5" x 6.5"	$4.70
P45x85	4.5" x 8.5"	$6.20
P45x170	4.5" x 17.0"	$11.35
P85x170	8.5" x 17.0"	$18.95

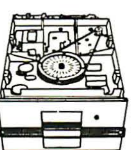
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IBM	$45.00
APPLE	$45.00
MULTIBUS	$86.00

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TEAC FD-55B



TANDON TM100-2

TANDON

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MPI

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TEAC

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FD-55F	½ HEIGHT DS/QUAD	$200.00

SHUGART

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SA 460	5¼" (80 TRACK) DS/QUAD	$199.95

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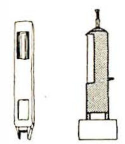




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INS-1416	for 14-16 pin IC's	$5.15
MOS-1416	for 14-16 pin IC's	$10.92
MOS-2428	for 24-28 pin IC's	$10.92
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MOS series insertion tools have metal constuction and include grounding lug for CMOS applications.

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BW-630

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- WSU-30M WRAPS AN EXTRA TURN OF INSULATION

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WSU-30/30M

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WWT-2	SINGLE SIDED	25/$4.25
WWT-3	IC SOCKET	25/$7.06
WWT-4	DOUBLE SIDED	25/2.80
INS-1	INSERTION TOOL	$3.64

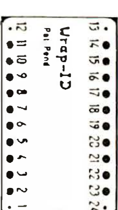
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- SLIPS OVER WIRE WRAP PINS
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14	IDWRAP 14	10	1.95
16	IDWRAP 16	10	1.95
18	IDWRAP 18	5	1.95
20	IDWRAP 20	5	1.95
22	IDWRAP 22	5	1.95
24	IDWRAP 24	5	1.95
28	IDWRAP 28	5	1.95
40	IDWRAP 40	5	1.95

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3	1.60	4.70	8.20
3.5	1.65	5.00	8.90
4	1.75	5.40	9.60
4.5	1.80	5.75	10.30
5	1.85	6.10	11.00
5.5	1.90	6.50	11.75
6	2.00	6.85	12.50
6.5	2.30	7.80	14.30
7	2.40	8.20	15.05
7.5	2.50	8.55	15.85
8	2.60	8.95	16.60
8.5	2.65	9.30	17.40
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20 MHz DUAL TRACE OSCILLOSCOPE

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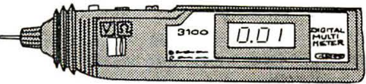
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Circle 210 on inquiry card.

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Clock Calendar	YES	YES
Game Adaptor	Optional	Optional

[1] withoptional 128KMAXISTACK
[2] second serial port optional

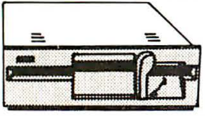
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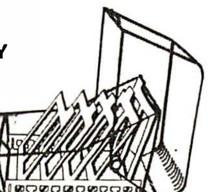
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DOUBLE SIDED, DOUBLE DENSITY
WITH HUB RINGS

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Circle 211 on inquiry card.

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WANTED: The Children's Haven School in Azrou, Morocco, seeks tax-deductible donation of any disk-based microcomputer system with printer for educational purposes. The Children's Haven is a nondenominational children's home. Fellowship of Independent Missions, POB 72, Fairless Hills, PA 19030, (215) 752-1170.

WANTED: Appalachian early-childhood program seeks donations of computer equipment and peripherals for database statistics and child-education modules. All donations covered under 1954 IRS 501 (c) (3) rules to a private, nonprofit corporation. Robert Hall, Knox County Economic Opportunity Council Inc., POB 135, Barbourville, KY 40906-0135, (606) 546-3152.

NEEDED: Nonprofit community agency seeks tax-deductible donation of microcomputer system for referral network, information management, and office assistance. Agency coordinates child-care resources for working families, private and government agency users, and handicapped children. Faith Rodgers, Community Coordinated Child Care of Union County, 60 Prince St., Elizabeth, NJ 07208, (201) 353-1621.

WANTED: Nonprofit group researching schizophrenia needs computer, disk drives, printer and A/D board for analysis of EEGs. PSR Research Group Ltd., 651 Lakecrest Dr., Menasha, WI 54952, (414) 722-9626.

WANTED: Small Lutheran grade school seeks tax-deductible donation of Commodore 64, datasette, disk drive, printer, or monitor, or Hewlett-Packard 85 for students to learn BASIC and Logo programming. Mike Hanke, Principal, St. James Lutheran School, 901 Shawano Ave., Green Bay, WI 54303, (414) 494-7782.

WANTED: Christian worker seeks tax-deductible donation of computer with word-processing capabilities for assisting with communication needs. Dan Rusch, c/o Overseas Missionary Fellowship, Batangas City 4201, Philippines.

WANTED: Tax-exempt, nonprofit, educational institution seeks information, suggestions, programs, and equipment for a business bulletin-board system at Tulane University. Anticipate tying together faculty, students, administration, alumni, and friends, but open to all ideas for potential uses. John Page, School of Business, Tulane University, New Orleans, LA 70118.

WANTED: Programmer father of visually impaired child seeks donation of powerful voice-activated computer to develop learning tools for the visually impaired. Tobias Jesso, 162 West 29th St., North Vancouver, British Columbia V7N 2J8, Canada.

WANTED: Computer-science student seeks donations of discarded, unused, or reparable computer equipment, especially ICs, monitors, keyboards, disk drives, to allow hands-on experience. Lucaz Batko, 30-328 Cracow, ul.Praska 8a, Poland.

FOR SALE: IBM PC, 128K, one disk drive, Epson RX-80 printer with parallel card, color-graphics adapter, and amber monitor: $2100. Andy Grosland, 604 19th St. NW, Austin, MN 55912, (507) 437-2465.

NEEDED: Pages 43–54 of Processor Technology's FOCAL interpreter listing, since mine are missing. Will pay for copy and shipment. H.-G. Willers, Blumenstrasse 28 D-8047, Karlsfeld, West Germany.

FOR SALE: Mountain Apple II cards, used. Five A/D+D/A cards: $175 each. Two multifunction cards: $150 each. Five Romplus+ cards: $100 each. Dixon Purcell, 7 Harvard Square, Brookline, MA 02146, (617) 738-4500.

FOR SALE: IBM I/O 735 typewriter-printer like new. Includes Selectric Computer Interface from December 1983 *Computers & Electronics*. Never used. Two type balls, spare parts, and factory timing tools. Complete package: $650 or best offer. Julian E. Jetzer, 6400 Hawthorn Rd., Sheboygan, WI 53081, (414) 457-3366 after 5 p.m.

FOR SALE: Alphamicro Systems Model AM1000 desktop computer, 68K with 128K memory, 10-megabyte hard disk, floppy disk, and VCR interface. Less than one year old, mint condition. Asking $7500 or best offer; $9500 value. Tommy Hawkins, 1128 Palm Dr., Burlingame, CA 94010, (415) 343-3853.

FOR SALE: 320K-byte IBM PC with two 180K and two 811K drives, green screen and adapter, serial port, 8087, NEC 8032A printer, and more. Best offer over $3500. Mark Bellon, 20 Elliott Ave., Centereach, NY 11720, (516) 585-5530.

WANTED: I want to hear from others interested in making the H/Z-19, the Imaginator graphics board, and the Super-19 PROM work together as a unit or in creating firmware to that end. I also want to compare notes with others using the Morrow DJDMA S-100 FDC board. Object is creating a BIOS to read/write additional formats. Carl Camper, POB 877, Colstrip, MT 59323.

WANTED: Your broken TRS-80 Color Computer and LPVII or DMP-100 printer. Give details. Joe Torzewski, 51625 Chestnut Rd., Granger, IN 46530.

FOR SALE: BYTE August 1981–July 1982, 12 issues: $35, postage paid in the U.S. Send check. If issues are sold, check will be returned immediately. David Cohen, 119 Surrey Lane, Westfield, NJ 07090.

FOR SALE: Radio Shack 16K memory upgrade (for Model III) in mint condition. Jed Weintrob, Apt. 11-D, 372 Central Park West, New York, NY 10025, (212) 663-8648.

WANTED: Junior high student needs complete micro system (prefers Apple) for programming and intellectual development. Would like 1200-bps modem and any unwanted peripherals. Will pay shipping. Robby Swenson, 660 West 5th, Colby, KS 67701.

WANTED: Readers who desire access to public-domain programs primarily for the Apple II. Includes utilities, games, graphics, business, educational, hobby, music, CP/M, Pascal, Apple III, and EAMON adventures. Will send a catalog if you send one 20¢ postage stamp. Please contact me if you want to start an Apple computer club. Daniel H. Lefler, POB 1962, Boulder, CO 80306.

WANTED: Student computer enthusiasts seek donation of printer that prints 10, 12, or 17 characters per inch and disk drives for TRS-80 Color Computer. Will pay shipping charges. Deborah Tisdale, 1026 Cedar Highland, Daytona Beach, FL 32017.

WANTED: High school electronics program seeks donations of electronic and computer hardware or components. Trying to run high-tech program on low-tech budget. Will pay shipping charges. William Stefek, Oswego High School, Rt. 71, Oswego, IL 60543, (312) 554-8256.

WANTED: People who have or need information on word processing in foreign languages. Send a SASE to Jerry Luzuriaga, 3149 Pebblestone Place, Simi Valley, CA 93063.

FOR SALE: Timex Sinclair 1000 with 16K memory module, all unused. Larry Martin, 13022 Lakeview Granada, Lakeside, CA 92040, (619) 443-3655.

WANTED: NEC PC-8000, PC-8200, or PC-8800 owners interested in a newsletter. Matthew Levie, 131 Riverside Dr., New York, NY 10024.

WANTED: Sanyo MBC owner starting informal users group to exchange information for Sanyo and other MS-DOS machines. Michael Russell, POB 2084CS, Pullman, WA 99163, (509) 878-1714.

WANTED: Users of 16-bit Perkin-Elmer computers. B. Freydin, POB 1407, DC21, TIS, Houston, TX 77251, (713) 972-4718.

WANTED: Used Osborne 1, prefer with DD. Will take subject to repair. F.L. Plotnick, POB 11264, Elkins Park, PA 19117, (215) 487-1443.

FOR SALE: Altair 8800B, MITS 300-55 with 5 megabytes fixed, 5 removable. Many manuals, 64K static RAM, turnkey panel, three serial, two parallel ports, Pertec 3442 10-megabyte disk drive with seven blank packs. Vector Graphic FD/HD disk controller included. Will split up. $1200 plus shipping. Joe Heck, 44 Commonwealth Ave., Stoughton, MA 02072, (617) 344-5009 evenings, weekends.

FOR SALE: Xerox 820 CPU board: $150. Commodore 64 with disk drive: $350. 80-column board: $125. Cardco printer interface: $40. Monitor: $40. 14-inch 26-megabyte Winchester: $200. Shugart SA851 without logic board: $50. Assorted magazines. Will consider offers. Dave Edick, POB 20673, Castro Valley, CA 94546, (415) 276-0981, 3–9 p.m.

FOR SALE: Eagle-PC2 includes 256K, two DS/DD drives, monitor, keyboard, two serial, one parallel port, service manual, Centronics parallel cable. All for $2650. Viriya Nimboonchaj, 2137 East 125th St., Brooklyn, NY 11229, (212) 645-1419 after 8 p.m.

FOR SALE: Sanyo 15-inch black-and-white monitor: $100. Tektronix RM503 oscilloscope, 500-KHz bandwidth, 1-mv sensitivity: $250. Micro-Sci disk controller for Apple II drive: $40. IDS 460G dot-matrix printer with serial/parallel interfaces and graphics capability: $500. Walter Sikonowiz, 2 Petre Dr., Auburn, NY 13021, (315) 252-3960 after 4:30 p.m.

FOR SALE: Hayes Smartmodem 300 bps: $200. Mountain Hardware multifunction card: $125. Used only two months. Bill Wilcox, POB 749, Pittsburg, CA 94565-0074, (415) 427-5994.

WANTED: Apple II+ compatible public-domain software that teaches Japanese on a basic or intermediate level. Also, public-domain database manager to handle comic-book collection. Marilyn I.M.C. McInnis, Box 1591, Honolulu, HI 96806.

FOR SALE: 48K Atari 400 with disk and tape drive, color monitor/TV joysticks, magazines, books, and manuals: $1800. Includes shipping. O. Chomer, 31175 Minton, Livonia, MI 48150, (313) 522-4953.

FOR SALE: Expanded Netronics Explorer 85 computer, like new. Includes six-slot S-100 card frame, 64K dynamic memory board, on-board monitor disk boot ROM, two 5¼-inch Tandon floppy-disk drives, disk-controller card, keyboard/video terminal with graphics, and complete documentation: $1500 negotiable. Robert Havanec, 106 Newport Ave., Shelton, CT 06484, (203) 735-4585 after 5:30 p.m.

WANTED: Living-room-quality furniture for IBM PC plus monitor and Mannesmann Tally Spirit 80 printer. Prefer lockable, enclosed cabinet or desk. T. Woods, 2651 Pacific Way, Longview, WA 98632.

WANTED: Correspondence, communication, literature for computer enthusiast in prison. Lee M. Robertson, POB 107, B-25493, Tehachapi, CA 93561.

FOR SALE: Franklin 1200 office management system and C.Itoh Prowriter printer. Includes Z80 and 6502 processors, 128K RAM, 80 columns, BMC monitor, cables, serial/parallel ports, extra manuals, and freight charge: $1850 or best offer. John Fellmeth, Box 1169, Monticello, UT 84535, (801) 587-2309.

FOR SALE: Apple II RV611C parallel printer interface in excellent condition: $50. Green Apple III monitor that could use cleaning: $50 or best offer. Kelly Priestly, 6554 McGill Way, Anchorage, AK 99502.

FOR SALE: IMSAI 8080 with Z80 and 8080 boards, MIO, VTI, 24K static, and 16K dynamic memory. North Star disk drive and controller. IBM Selectric and interface, 9-inch monitor, and two keyboards. Needs minor work. Best offer. Austin L. Ely, Rt. 1, Box 234-C, Lindale, TX 75771, (214) 882-9195.

FOR SALE: Memory chips 2708 1024x8 EPROMs: $3. 74S475 512x8 PROMs: $4. 82S23 32x8 PROM: $2. 4027 4Kx1 dynamic RAMs: $2. Bill Gill, 310 Portsmouth Rd., Cherry Hill, NJ 08034, (609) 428-0943.

(continued)

UNCLASSIFIED POLICY: *Readers who have computer equipment to buy, sell, or trade or who are requesting or giving advice may send a notice to BYTE for inclusion in the Unclassified Ads section. To be considered for publication, an advertisement must be noncommercial and nonprofit (individuals or bona fide computer clubs), typed double-spaced, contain 60 words or less, and include name and address. This is a free service; notices are printed as space permits. Your confirmation of placement is appearance in an issue of BYTE as we engage in no correspondence. Please allow at least four months for your ad to appear. Send your notices to BYTE, Unclassified Ads, POB 372, Hancock, NH 03449.*

FOR SALE: *Softalk for IBM*: July 1982, September 1982–March 1984. *PC Tech*: Vol. 1 No. 1–7. *PC Age*: April 1982, September 1982–March 1984. *PC Magazine*: Vol. 1 No. 2–Vol. 3 No. 8. *PC World*: Vol. 1 No. 1–Vol. 2 No. 5. BYTE: April 1983–April 1984. Best offer per issue or set. Ken Holcombe, 178 Tipperary, San Antonio, TX 78223, (512) 333-5442.

FOR SALE: S-100 bus computer system, four slots, Z80A with 64K, two RS-232 ports, one Centronics parallel port, two 5¼-inch single-sided quad-density drives with controller (takes 8-inch drives), Liberty 50 terminal, Gemini-10X printer, and full documentation. Cost $3700; asking $2200 or offer. Robert Franklin, 36 Fiesta Dr., Joliet, IL 60432, (815) 722-3550.

FOR SALE: Cromemco Z2D; TeleVideo 920C with second page and cover. Motherboard: 21 slots, S-100. Boards: 16FDC Rev E (needs work), 64KZ(NW), PRI, ZPU Rev E. Disk drives: two Tandon TM100, 5¼-inch DS/DD, 360K/disk. All manuals and *IO News*. Value new: $5660; best offer. Barry Norris, 17 Danbury Rd., Apt. #3, Ridgefield, CT 06877, (203) 431-6868.

FOR SALE: New Heath H-89 microcomputer. Professionally built with deluxe amber CRT, single floppy-disk drive, 48K RAM. Epson RX-80 printer with interface. Includes all manuals and dust covers: $1000. Will deliver within 125 miles (NW Illinois). James Pepper, 808 East Third St., Sterling, IL 61081, (815) 625-0560 weekdays 8–5.

FOR SALE: Epson Super Terminal printer, MP-80 F/T type 2 (bit image) with Graftrax 80 (same as MX-80): $200. Yukio Masuda, 109 Country Place Nells Rock Rd., Shelton, CT 06484.

FOR SALE: Used El Cid interface between any computer and a phototypesetter: $600 ($700 new). Works great. Sam Warren, 2543 Broadway, San Diego, CA 92102, (619) 232-5901 after 6 p.m.

FOR SALE OR TRADE: Epson HX-20 notebook portable computer; can include some free phone consulting. $700 or best offer. Eric Balkan, 14704 Seneca Castle Court, Gaithersburg, MD 20878, (301) 762-7145.

FOR SALE: HP 85 portable with 32K main memory, 32-character internal thermal printer, 255 by 191 high-resolution graphics display, and 210K tape drive. Peripherals are built in. Includes application books and case: $800 or best offer. Alex Witkowski, 6 East 97th St., New York, NY 10029, (212) 289-7578.

FOR SALE: Shugart disk drive Model SA-400 in good working condition: $55 UPS postpaid. R. Mendelson, 27 Somerset Place, Murray Hill, NJ 07974.

FOR SALE: Victor 9000: 8086 16-bit 128K RAM expandable with two 640K 5¼-inch single-sided disk drives, green phosphor graphics monitor, and programmer's keyboard. List $3495; asking $2000. J. T. Gruber, 154 Shady Oak Trail, Charlotte, NC 28210, (704) 554-0833.

WANTED: 16K, 32K, or 64K TRS-80, Apple, Atari, or Adam. David Ford, 7747 Weston Richmond Heights, St. Louis, MO 63117.

FOR SALE: Xerox 820 IDS, including display and two drives, in excellent condition: $1195. 3M 051 copier: $50. H. L. Whitaker, 9639 Dorothy Ave., South Gate, CA 90280, (213) 567-8758.

FOR SALE: Hewlett-Packard HP 85A, 16K memory module (32K RAM), ROM drawer, matrix ROM, documentation, dust cover, paper: $1500. Gregory Wolters, 13812 Winding Way, Nevada City, CA 95959, (916) 265-9445 days, (916) 273-1728 evenings.

FOR SALE: TRS-80 Model III, 48K RAM: $550. Radio Shack Line Printer VIII: $400. Both one year old and in excellent condition. Nathan Nathan, 104-20 Queens Blvd. #6W, Forest Hills, NY 11375, (212) 275-2052 evenings.

NEEDED: TRS-80 Model III users interested in starting an Adventure Club. Your adventure programs would be appreciated for a newsletter. Eric Yoxtheimer, 486 Cedar Cove Rd., Ellensburg, WA 98926.

WANTED: High school student seeks donation of computer system and peripherals, disks, or books for programming and experimentation. Will pay postage. Jim Jenkinson, 17 Marion Rd., Montvale, NJ 07645.

WANTED: High school student seeks donation of electronic or computer equipment. Will pay postage. Chris Rosin, 6565 North Pine Shore Dr., Glendale, WI 53209.

FOR SALE: Five Digital VK100-AA (GIGI), with keyboard overlays and three carrying cases. Never unpacked. List price $12,750; asking $7500. Agustin Dorantes, 5 Footpath Rd., Chelmsford, MA 01824, (617) 251-7235 evenings.

FOR SALE: Fortune System 10 multiuser system with 512K memo y, asynchronous ports, and NEC 3500I printer. Will consider trade for Apple or IBM PC. M. B. Motwani, 2741 Binbrooke, Troy, MI 48084.

FOR SALE: TRS-80 Level II BASIC and programming book in excellent condition: $14. Andrew Spinola, 8 Masefield Dr., Greenlawn, NY 11740.

FOR SALE: Pronto Series 16 computer, MS-DOS 2.0 and IBM PC compatible. 256K RAM, green swivel/tilt high-resolution monitor. Uses Intel 80186 CPU. One 800K floppy-disk drive and one removable Winchester cartridge (5 megabytes): $3995 or best offer. David Klotzbach, 25 Columbia Circle, Plymouth, MA 02360, (617) 747-0430.

FOR SALE: HP9831A: $575. HP9866B: $850. Pay by certified check or money order. Wanted: HP98032A OPT 062 parallel interface, HP98036A serial interface (preferably OPT 071), HP98223A ROM, HP98218 ROM, HP9885M/S flexible disk drives. R. W. Houston, Box 1881, APO San Francisco, CA 96328.

FOR SALE: Alpha-Micro computer, AM-1000VWF, two TeleVideo CRTs, one Texas Instruments 810 printer and stand, 10-megabyte Winchester disk add-on (20-megabyte total), one telephone modem: six months old. Originally $27,500; asking $20,000 or best offer. Arthur C. Jay, 350 N 400W, Lebanon, IN 46052, (317) 482-6138 after 5 p.m.

FOR SALE: Frieden/Singer Flexowriter printing terminal with illuminated status panel, 110 baud, block type (upper- and lowercase), 115 vac. Spare electronics package (slightly cannibalized). Each package contains thirteen 7- by 9-inch cards in cage. Full documentation. Best offer, no shipping, local pickup only. William Simpson, 5600 Glenford St., Los Angeles, CA 90008, (213) 293-2959.

WANTED: College student seeks donation of computer equipment and books for experimentation and programming. David Wagenknecht, 2421 Beeler Ave., York, PA 17404.

FOR SALE: Panasonic JR-200U personal computer, new. 16K ROM containing BASIC and machine-code monitor, 32K usable RAM, Centronics-type printer port, expansion bus, high-speed cassette interface, sound generator, cables, and technical manuals: $150. Joe Smiley, 11-A Rector Court, Wilmington, DE 19810, (302) 453-3616 days, (302) 475-8879 nights.

WANTED: Altos U.K. 5-5 hard disk for Altos 5-15D computer. Mr. Scott, Scott & Byrd, P.A., P.O. Drawer 6105, Florence, SC 29502.

WANTED: College student seeks donation of technical drawing equipment. Valdemir Santos, Rua Madre Cabrini, 406-11, São Paulo–SP, Brazil 04020.

WANTED: Used Anchor Automation Signalman Mark XII 300/1200-bps modem or Hayes Smartmodem. Also, help finding a VT102 emulator for the Lobo MAX-80 running under CP/M-80 2.2: David Lewis, Union College, Box 1927, Schenectady, NY 12308.

FOR SALE: Radio Shack PC-2 pocket computer: $120. POC-2 plotter/printer interface: $140. RS-232C: $160. 8K RAM expansion module: $100. Vinyl case for PC-2 and plotter/printer: $15. Excellent condition, includes documentation. $1200 value; asking $500 for package. Linwood McDowell, 821 North McKnight Rd. #D, University City, MO 63132, (314) 993-5068 evenings before 10 p.m.

FOR SALE: Excellent letter-quality Smith Corona TP-I printer. Parallel interface, 10 characters per inch, two daisy wheels, two ribbons, dust cover. Retail $895; asking $275, plus free shipping. Brett Bobley, 98 High Farms Rd., Glen Head, NY 11545, (516) 671-6707.

FOR SALE: BYTE Vol. 5 No. 4 through present. First money order for $200 receives set. Include SASE. Rick Kosakowski, 13 Columbia Dr., Feeding Hills, MA 01030.

WANTED: High school student seeks donated computer equipment or books in any condition, especially for Apple II, Commodore 64, or Timex. Will pay postage. Boyce Johnson, 221 East Minnesota St., Cannon Falls, MN 55009.

WANTED: High school student seeks donation of Apple IIc, Password modem, Apple II disk drive, or color monitor. Steven L. Pfirman, RD #1, Box 212, Mifflinburg, PA 17844, (717) 966-1734.

FOR SALE: Complete set of BYTE in good condition from issue No. 1 to the present: $400. Robert G. Lloyd, 7554 Southgate Rd., Fayetteville, NC 28304, (919) 867-5822 after 6 p.m.

FOR SALE: IBM Selectric-to-microcomputer (RS-232) interface box by Escon Products. Like new: $199 or offer. Gary Gordon, 21112 Bank Mill Rd., Saratoga, CA 95070, (415) 857-4958 days, (408) 867-6796.

WANTED: Electrical engineering student would appreciate donated computer or electronic equipment in any condition. Will pay postage. Wayne Poole, 8926 Byron Ave., Surfside, FL 33154.

FOR SALE: Texas Instruments 99/4A, joysticks, dual cassette cable, five issues of *99'er*. Includes books and connections. In very good condition: $300 or best offer. Steven Jabitsky, 440 Bradley Ave., Staten Island, NY 10314, (212) 698-4705.

WANTED: Hard disk for DEC Rainbow or separate controller. 10 megabyte preferred, 5 considered. Adam Cohen, 38800 Hastings St., Apt. 93, Fremont, CA 94536.

FOR SALE: Five boxes (50) brand new Verbatim MD525-01 SS/SD 5¼-inch soft-sectored floppy disks: $110 includes shipping. Michael Collins, 5619 West Commonwealth Place, Chandler, AZ 85224.

FOR SALE: S-100 boards. CompuPro RAM20 32K static RAM: $150. Measurement Systems DMB6400 64K dynamic RAM: $200. Mountain 100,000 day clock: $150. All plus UPS COD. Jerry Throckmorton, (513) 426-8781.

FOR SALE: IMSAI 8080 microprocessor, 22 slots, 28-amp supply, fan, PIO-4, SIO-2, and Op-panel. Other boards: 48K DRAM (SDS ExpandoRAM), two 8K RAMs, VDM-1, extender board, and custom WW board, GRI keyboard, two PHI-DECK drives, and controller. Original documents. Complete set: $1000. Tandon TM100-1: $100. Steven Munroe, 613 30th St. NE, Rochester, MN 55904, (507) 289-3359 after 6 p.m.

FOR SALE: Xerox 820-II computer system with 80-column black-and-white display/processor, dual 8-inch SS/DD drives, advanced keyboard, and more. All manuals and cables. In perfect condition—less than 40 hours logged. Total value $5700; asking $2900. C. Wolma, POB 959, Galveston, TX 77553.

FOR SALE: Compucolor II, keyboard, dual drives, 32K, documentation: $1200. Morrow Micro Decision, disk drives, 64K, documentation, no monitor: $900. Diablo 630, print wheels: $1500. Votrax Type N' Talk: $110. Novation CAT modem: $70. MFJ RS-232 transfer switches: $40 and $50. TDC RS-232 junction box: $25. TI SR-52 and programmer calculators: $40 each. Novus 6010 calculator: $25. W. A. Shanks, 1345 West Escarpa, Mesa, AZ 85201.

FOR SALE: Micromint MPX-16 computer board with power supply and keyboard adapter, 64K and support ROMs for a terminal or IBM-type keyboard and graphics card. New $1500; sell $1050. Also, Hazeltine 1421 terminal: $375. Radio Shack Modem II: $125. Frank Wasacz, 1256 Pennsylvania Ave., Columbus, OH 43201, (614) 424-4053 days, (614) 291-2166 evenings.

WANTED: High school student would appreciate any unwanted computer parts, accessories, or systems for educational purposes. Derek Badour, 1124 Clay Rd., Union City, MI 49094.

FOR SALE: Epson QX-10 computer with 256K dual disk drives and monitor in excellent condition. Used two months. Best offer over $2200. G. Jamriska, 2960 Hawkridge Dr., La Crescenta, CA 91214.

FOR SALE: New Diablo P-11 dot-matrix printer with parallel interface, italics, underlining, compressed/expanded characters, 10-inch carriage, 100 cps: $274 (list: $649) with warranty. Erin Williamson, Rt. 2, 35 Totteridge Dr., Wellford, SC 29385, (803) 877-9828.

FOR SALE: IBM PCjr with 128K and built-in DS/DD drive. Purchased February 1984 for $1300; sacrifice at $995. Tom, 609 South Escondido Blvd. #101, Escondido, CA 92025, (619) 743-0494.

FOR SALE: Used TI 763 silent 700 printing terminal with 20K bubble memory, RS-232, works well; best offer at least $500. Qume QVT-102 green 80 by 24 terminal: $550 delivered, firm. Irving Wolfe, 119 Aloha St., Seattle, WA 98109, (206) 282-9598.

FOR SALE: Two ADM 31 smart terminals; Intermec 9300 bar-code reader and 9400 po table reader with wands, interface, and power adapters; two Apple III floppy-disk drives; Silentype thermal printer; Super Serial card for Apple II. All manuals

included. Excellent condition. Mark Kuster, 521 Scott Ave., Dalhart, TX 79022, (806) 249-5287.

FOR SALE: Hewlett-Packard 9816S, 512K bytes of RAM, 9121D dual disk drive, HP-IB and serial interface, HP-IB cable. Like new. HP catalog price over $10,000; sacrifice at $5995. Will ship UPS insured for $30. Kerry Newcom, 10 Evergreen Ave., Burlington, MA 01803, (617) 273-1818.

WANTED: Two Osborne/McGraw-Hill books: *Z-80 Programming for Logic Design* and *An Introduction to Microcomputers: Vol. 3—Some Real Support Devices.* Describe condition and price. Bruce Welch, 12 Sage Grouse Rd., Novato, CA 94947.

WANTED: People interested in a Sanyo MBC-550 users club for the Detroit area. David P. Stroup, 45448 Margate Dr., Mt. Clemens, MI 48044.

FOR SALE: VIC 1525 graphics printer; best offer. Teri Grossman, 1111 River Rd., Edgewater, NJ 07020, (201) 886-0980.

FOR SALE: Heathkit H14 printer with variable columns per line, type fonts, baud rates, and many other features; requires serial RS-232 interface: $300 or best offer. Complete set of Model 28 Teletype manuals: $50 or best offer. Used RF signal generator and 10,000-volt power supply: $10 plus postage. Donald Mayes, 8515 Greenwood Ave., Apt. 3, Takoma Park, MD 20912, (301) 589-4190.

WANTED: High school student needs Apple equipment and peripherals for programming. Will pay postage. Jean-Paul Cativiela, 300 East Bellevue #209, Pasadena, CA 91101, (818) 792-8921.

WANTED: VIC-20 owners who want to trade magazines, books, information, ideas for good programs, and VIC tricks. Neil Phillips, POB 1489, Niagara-on-the-Lake, Ontario L0S 1J0, Canada.

FOR SALE: Quadlink by Quadram (to make an IBM PC Apple-compatible). Includes board, all necessary software, and manual. Works like new. Original cost $680; sell for $450. J. Theodore Repa, 18 Bonnett Ave., Larchmont, NY 10538, (914) 834-7207 evenings.

FOR SALE: BYTE, excellent condition, 1977–1983 (except November 1982 missing and September 1979 damaged): $300 plus shipping. J. E. Burchfield, 6 Bonus Hill Dr., Scotch Plains, NJ 07076, (201) 757-9441.

FOR SALE: BYTE April 1980–December 1982: $80 or best offer. Jonathan Marshall, 10 Ibbetson, Somerville, MA 02143.

FOR SALE: Visual 500 graphics terminal five months old: $1795. Freedom 100 terminal: $375. Buzz Coors, 2107 Artesia Blvd., Redondo Beach, CA 90278.

WANTED: *Compute!'s Gazette*: December 1983–February 1984. *RUN*: January and February 1984. J. E. Pritchett, POB 127, Thomaston, AL 36783.

FOR SALE: Hewlett-Packard HP 85A with 32K memory, advanced programming ROM, plotter/printer ROM, input/output ROM, mass storage ROM, matrix ROM, assembler ROM, HP-IB, and carrying case. John M. Uber, 1154 North Howard St., Akron, OH 44310, (216) 923-2074.

FOR SALE: Rodime RO100 hard disk, 5.33 megabytes formatted, unused, tested with certification, ST506 protocol: $500. Mark Cohen, Box 223, 1230 York Ave., New York, NY 10021, (212) 570-8667 days, (212) 988-6203 evenings.

FOR SALE: BYTE No. 1 through June 1984: $325 plus UPS. *Kilobaud* No. 1–48 except No. 31: $110 plus UPS. R. W. Moell, 213 Stillwood Dr., Wake Forest, NC 27587, (919) 528-2713.

FOR SALE: TRS-80 Model 100 (28K) used 10 hours, with cassette recorder, printer, and modem cables: $700. Lynn Morano, 87 Sand Pit Rd., Danbury, CT 06810, (203) 743-6868.

WANTED: Student seeks donation of any computer equipment for research. Michael Santos, 20 North Domingo St., San Juan, Metro Manila, 3134, Philippines.

FOR SALE: 40–80-column Apple switch box, microwave antenna, satellite TV receiver. Mr. Wang, POB 68-1257, Taipei, Taiwan.

FOR SALE: Hewlett-Packard 7470A digital plotter in excellent condition: $850. Also, Houston Instruments DMP-7 digital plotter in good condition: $400. Lawrence L. Morton, 21671 Superior Lane, Lake Forest, CA 92630, (714) 859-6015.

WANTED: Schematics for Data General Nova 2 minicomputer. Will pay postage and reasonable copying costs. Irvin Van Dreumel, RD #2, Solon Pond Rd., Cincinnatus, NY 13040, (607) 863-3568.

WANTED: Any unwanted Apple peripherals, cards, manuals, books, or magazines for student. Tay Teck Wah, 51, Jalan Batai, Damansara Heights, Kuala Lumpur, Malaysia.

FOR SALE: Hewlett-Packard Series 80 (for 85, 86, 87) 82909 RS-232 interface: $300. IDS 560G 200-cps printer: $850. 9130A disk drive for 86A: $450. Customized HP-41C calculator with modules: $285; 82161 HP-IL tape drive: $285. Both for $580. Randy Webb, 622 East 11th St., Bloomington, IN 47401, (812) 335-1858 days, (812) 339-7661 after 5 p.m.

WANTED: High school student seeks donation of computer system, disk drive, books, printer, or disks for school projects and experimentation. Will pay postage. Also, selling TS 1000 with 16K pack, typewriter keyboard, books, adapter, and cables. New $270; sell at $125. Peter Huss, 229 Misty Way, Grayling, MI 49738, (517) 348-8062.

WANTED: Disabled person with extensive knowledge of COBOL, RPG II, CBASIC, MBASIC, and PL/I seeks donation of boards, disk drives, monitor, etc. (Apple IIe or Commodore 64) for development of educational software. Will pay shipping and issue receipt. Lloyd Wynter, 170-20 130 Ave., #2d, NY 11434.

WANTED: High school student seeks donation of computer system with disk drive and books, preferably with printer and IBM compatible. George F. Gomes, 17112 Willard St., Van Nuys, CA 91406.

FOR SALE: BYTE Vol. 1, No. 3, November 1975: $5. Dave Lambarth, Old Amherst Rd., Mont Vernon, NH 03057, (603) 884-6177 days, (603) 673-3566 evenings and weekends.

FOR SALE: TRS-80 Model 100, 32K RAM, disk/video interface (single drive), cables, bar-code reader, and Epson MX-80 printer with Graftrax: $1800 negotiable. TRS-80 Model III, 48K RAM, two disk drives, printer cable, and Daisy Wheel II printer: $2200 negotiable. Both include manuals, books, and magazines. Mark Paulhus, 52 Dwight St., New Britain, CT 06051, (203) 224-3309.

FOR SALE: 2164 64Kx1 dynamic RAMs 150 nanosecond. Nine for $39. Joseph Hoock, 50 Hazelhurst Dr., Rochester, NY 14606.

FOR SALE: HP 9830A computer (with BASIC and one-line display), HP9866A thermal printer, and magnetic card reader. All in good working condition; best offer. Ezra Malek 72-81 113 St., Forest Hills, NY 11375, (212) 263-6056.

FOR SALE: Micromint COMM-80 TRS-80 serial/parallel interface with manual, never used: $100. Zenith ZT-1 communications terminal, built-in 300-bps modem, parallel printer port, detached keyboard, and green phosphor monitor, new condition: $400. Apple II monitor: $150. Jeff Shumate, 5807 Warwick Place, Columbus, GA 31904, (404) 876-3240.

FOR SALE: Almost new Apple IIe 80-column card: $90. Timex/Sinclair Zon X-81 music and sound synthesizer: $50. DKtronics character generator: $45. 16K RAM: $30. All in good condition. Tim Edwards, POB 56, Smithfield, VA 23430.

FOR SALE: TI 99/4A with peripheral expansion system, disk-controller card (with disk manager cartridge), disk drive, memory expansion card (32K RAM), RS-232 card, Gemini-10X printer, and manuals: $1700. Tony Auter, 3505 Mina Court, Louisville, KY 40220, (502) 454-4410.

FOR SALE: BYTE No. 1 through August 1979, mint: $120 includes shipping. John Gibson, 1075 Sterling, Berkeley, CA 94708.

WANTED: First 16 issues of BYTE; name your price. Larry Coulter, Box 441, Pequot Lakes, MN 56472, (218) 568-4115 days, (218) 543-4446 evenings.

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FOR SALE: BYTE in binders, July 1976–February 1983, immaculate: $50. 19-inch color monitor, documentation, top quality: $350. Digital VOM meter (lab quality), immaculate, provision for battery, BCD output, documentation: $250. Analog VOM meter (top quality), palm-sized: $25. Jim Rosa, 6401 Crescent Ave., Buena Park, CA 90620, (714) 937-1771/827-6334.

FOR SALE: 128K Apple III with parallel interface card and green monitor, Apple dot-matrix printer, external disk drive, and custom table: $4200 negotiable. Will consider selling by piece. Marilyn Beckett, 227 East Third St., Moscow, ID 83843, (208) 882-2330.

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6. Names and addresses of publisher, editor, and managing editor: Publisher; Gene W. Simpson—70 Main St., Peterborough, NH 03458; Editor, Philip Lemmons—70 Main St., Peterborough, NH 03458; Managing Editor, Gene Smarte—70 Main St., Peterborough, NH 03458

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DISK INTEREST

Robert Rodina wins $100 for his first-place subjective evaluation, "Comparing Floppy Disks," which appeared in the September issue of BYTE. In second place is Lester E. Thompson's clarification on the incompatibility and standardization of "Floppy-Disk Formats." Mr. Thompson wins $50. "Fractals," Peter Sørensen's exposé on mathematical discoveries in fractional dimensions, won third place. Jerry Pournelle's Computing at Chaos Manor came in fourth, written while he was "On the Road." And in fifth place is Steve Ciarcia's "Build the AC Power Monitor." Congratulations, authors.

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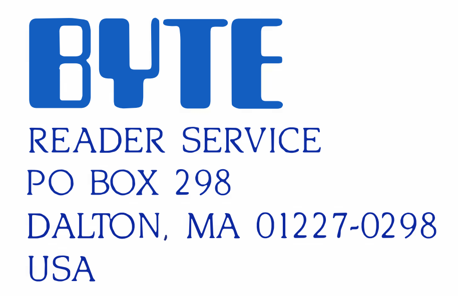
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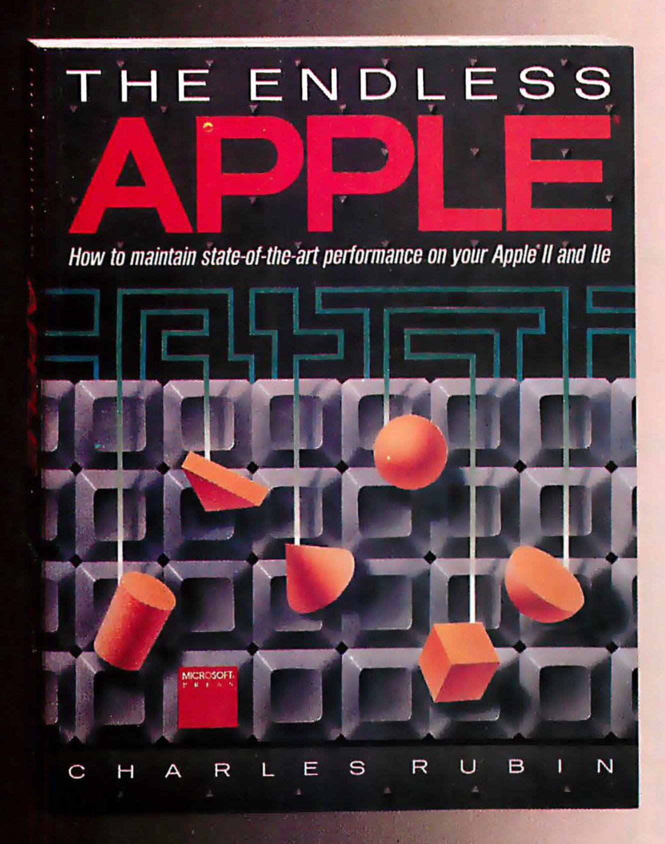


BYTE
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Guide to the APPLE Personal Computers

Apple IIe Apple IIc Macintosh Lisa 2

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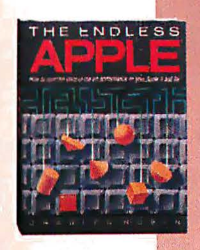


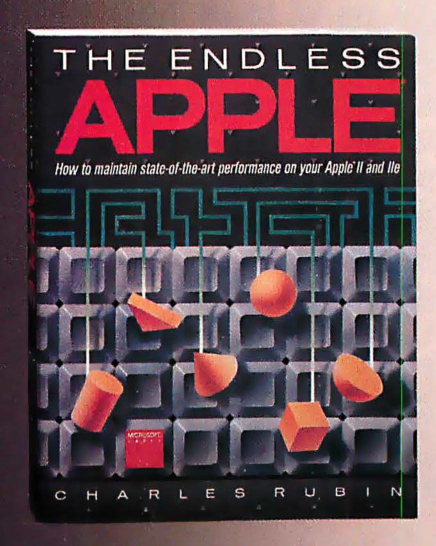
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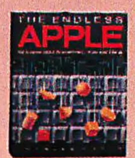
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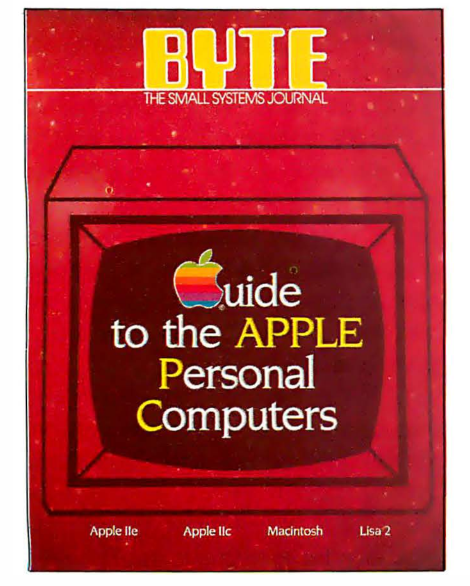






BYTE

APPLE guide



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Apple and Its Personal Computers

There are two kinds of people in the world: people who say Apple isn't just a company, it's a cause; and people who say Apple isn't a cause, it's just a company. Both groups are right. Nature has suspended the principle of noncontradiction where Apple is concerned.

Apple is more than just a company because its founding has some of the qualities of myth. Yes, Jobs and Wozniak made specific decisions that made Apple successful. They gave us the autoboot ROM, the first "warm" plastic computer, and the open hardware bus. But Apple is more than the insight reflected in those decisions. Apple is two guys in a garage undertaking the mission of bringing computing power, once reserved for big corporations, to ordinary individuals with ordinary budgets. The company's growth from two guys to a billion-dollar corporation exemplifies the American Dream. Even as a large corporation, Apple plays David to IBM's Goliath, and thus has the sympathetic role in that myth.

Our minds automatically make a lot of allowances for Apple. If it takes eight years for Apple to bring out an 80-column card, we'll wait or settle for a nonstandard card that does the job. We can read a slogan such as "Apple II Forever," which defies everything we know about rapid technological progress, and feel nostalgic rather than derisive. We can forgive the Lisa's performance problems because we embraced the concept of the user interface. We can wait months for the essential second drive for Macintosh and write scarcely a word of criticism.

But Apple the myth causes us to expose Apple the company to some forms of criticism that we don't make of its competitors. If another company's prices seem high, we criticize them but don't feel betrayed. Apple's high prices seem to betray its mission. If another company makes high profits, we think that's probably good because the company will continue to support its products. If Apple's profits go up sixfold in one quarter, we wonder again if the company is betraying its mission of bringing computer power to ordinary people. If Apple introduces a computer with no expansion slots, it isn't just a bad decision. It's almost like the violation of an implied warranty. That famous Apple logo seems to promise openness in every respect.

Apple's computers make a strange and wonderful family. As a product line, they are coherent even though they lack media and data compatibility (again defying the principle of noncontradiction). The Apple II computers, the Apple III, the Macintoshes, and the Lisas all have different operating systems and disk formats. Each of the individual machines is an anomaly. Macintosh has a vast memory-address space and severely constrained memory. Lisa has lots of memory and 10 megabytes of hard disk and still runs slowly. The Apple IIc would be a portable, but it lacks a power supply, a power source, and a flat display. It would be Apple IIe-compatible, but it has differences in ROM and a processor with additional instructions. The Apple IIe is a refined version of a 10-year-old machine that expands memory to 128K by mirroring the strange addressing of the first 64K. The Apple III is a refined version of a 10-year-old machine that uses clever hardware to address 256K bytes of RAM without bank switching.

What makes all this coherent? What makes these machines sell like mad? It isn't the myth, it's the ethos. All these different machines are unmistakably Apple. They are an oasis of defiance in a sea of compatibility. And most important, all these machines let you run applications software by using a mouse to point and select.

It's the commitment to ease of use that salvages part of Apple's mission. Maybe Saints Steve and Steve aren't making computer power easy for everyone to afford, but they are making it easy for everyone to use. Qualified sainthood is better than none.

—*Phil Lemmons, Editor in Chief*

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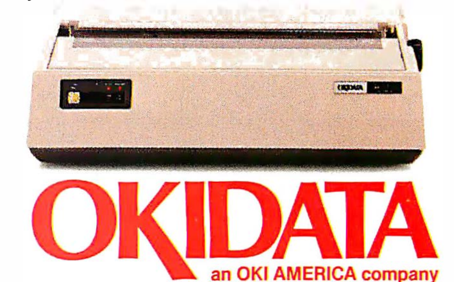
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PART I

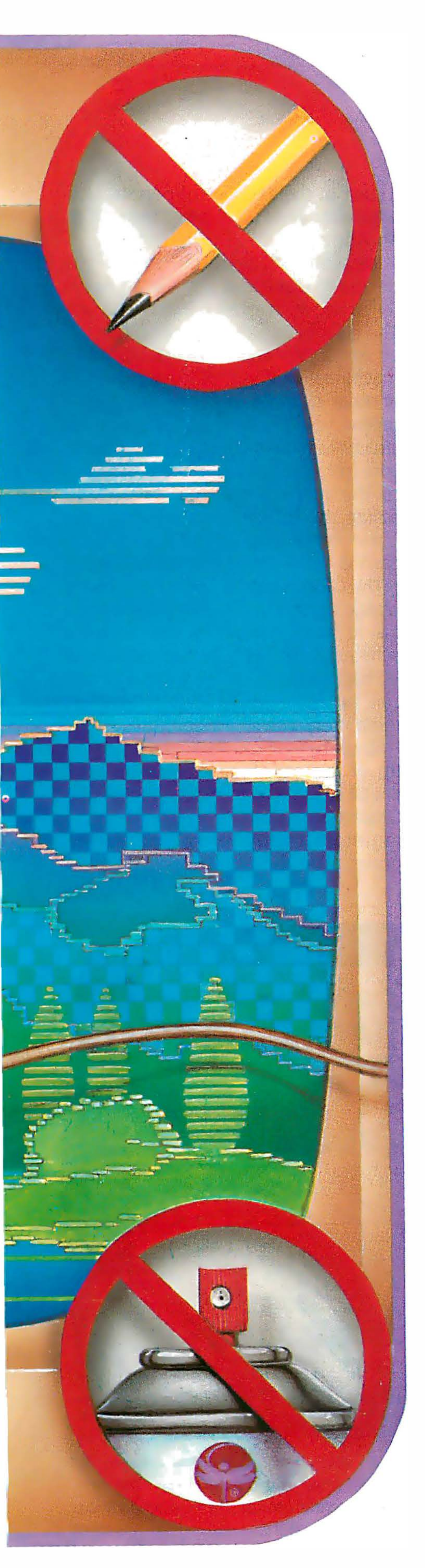
THE APPLE II, A COMPUTER THAT ENDURES



ILLUSTRATION BY ROBERT TINNEY



ILLUSTRATION BY WILLIAM A. GIESE



ARTISTIC TOOLS FOR THE APPLE II FAMILY

Apple's AppleMouse II and MousePaint contrasted to Koala's Gibson Light Pen System

BY ERIC ELDRED

You may not be artistic, but two easy-to-use programs from Apple and Koala could change that. Apple has produced its mouse for the Apple II family and bundled it with a program by Bill Budge of Pinball Construction Set fame. MousePaint 1.0, Budge's adaptation of Bill Atkinson's MacPaint program for the Macintosh, is an incredible feat of 6502 programming.

The AppleMouse II connects directly to the Apple IIc game port or to the Apple II, II+, and IIe through a peripheral board.

The mouse's chief competitor as a drawing tool is the Gibson Light Pen System (formerly called LPS II), first developed in 1982 by Steve Gibson and now marketed by Koala Technologies Corporation.

Both systems surpass other drawing tools by using the full 280- by 192-pixel high-resolution screen in six colors plus shades, patterns, and text. Their fast machine-language programs introduce Apple's "Lisa technology" user interface to the Apple II world.

APPLEMOUSE II

AppleMouse II has a nice feel inside an adult's palm. The ball is rubber-covered and rolls comfortably. The two tiny plastic feet at the front, which keep the mouse level, do mar shiny desk surfaces, emit a scratchy sound, and will wear out with unusually heavy use.

AppleMouse's button feels much more responsive than the one on the original Lisa mouse. The button does not correspond to any key on the keyboard or the paddle buttons but is read at a screen "hole" memory location, bit 7 of $778 plus the slot.

Installing the mouse is easy. To use it, you need a flat surface up to about a foot square optimally. From BASIC you can access up to 1024 discrete points, which takes the mouse about 11 inches for full travel. From machine language, you can access the full integer range, which would be more area than most desktops provide unless you "clamped" the range. The resolution is stated to be 0.020 inch (0.5 mm). Cary Lu's *Apple Macintosh Book* (Microsoft Press, 1984) tells you how to add crosshairs to the mouse for such accurate digitizing.

The documentation states that the mouse card fits any Apple II slot, but actually MousePaint emits an error message if it finds the board in slot 3, which is reserved for an 80-column text card or non-ROM card. Slot 4 seems the most compatible with Apple IIc software, but this may be an unlucky choice, as ProDOS expects the second disk-drive controller to be in slot 4. You can secure the Mouse easily in the rear

(continued)

Eric Eldred is currently president of the Southern New Hampshire Apple Core users group (SNAC). He can be reached at RFD 2, English Range Rd., Derry, NH 03038.

AT A GLANCE

Name
AppleMouse II and Mouse-Paint 1.0

Type
High-resolution mouse, interface, graphics software

Manufacturer
Apple Computer Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010

Price
$149 ($99 for Apple IIc version)

Author
Bill Budge

Format
One 5¼-inch disk, ProDOS 1.0.1, not copy-protected

Language
Applesoft BASIC, listable and modifiable; MousePaint in machine language

Computers
64K-byte Apple II, II+, IIe, or IIc; Apple II compatibles with nonsupplied patches; demo program needs Applesoft in ROM

Documentation
56-page users manual; interface ROM entry points, no schematic

opening of the II+ or IIe case between a ribbon cable permanently attached to the card and a DB-9S connection from the mouse cable. The AppleMouse II card is the first one I have seen from Apple that is issued without a schematic, and I don't like that. It has a couple of socketed ROMs and a 6821 microprocessor. Two solder jumpers may accommodate a larger ROM in the future.

You can use either a monochrome monitor or a color TV or monitor with the Mouse; though I didn't try one, an RGB (red, green, blue) monitor should also be fine.

Gibson Hardware

The Gibson pen runs under Apple DOS 3.3 on a 64K-byte Apple II+ or IIe, but not on an Apple IIc, and needs Applesoft in ROM.

The pen does not take advantage of an 80-column board nor use the double-high-resolution graphics of the Apple IIe. Gibson went to great care to make the pen work with all revisions of the Apple II motherboard, even European 50-Hz Apples, which have slightly different video hardware. Koala has opted to make the new software easy to use, at the expense of portability to a wide range of machines. I tested it on an Apple IIe.

Installation is relatively easy if you decide to place it in slot 7 in an Apple II+ or IIe with a revision B motherboard. The card needs a video signal present at slot 7 of those machines. In other machines, or if you place the card in another slot, the light pen won't work unless you follow the inadequate instructions in the manual to clip a jumper wire from the card onto a pin of a chip on the motherboard. You may have to adjust the disk-drive cables from the controller in slot 6 if the wide Gibson card in slot 7 fits tightly against them.

The Gibson card is sealed in a heavy plastic case so you cannot see the chips inside, and Gibson does not provide a schematic. The light pen comes with a 90-day warranty, or for a flat $55 you can have the card or pen repaired thereafter—unless it's been misused.

Since the light cell, recessed inside the tip of the pen, reads the 60-Hz horizontal scan signal from the monitor, the Gibson pen just won't work with certain monitors with long persisting phosphors—the Apple Monitor III, USI

(continued)

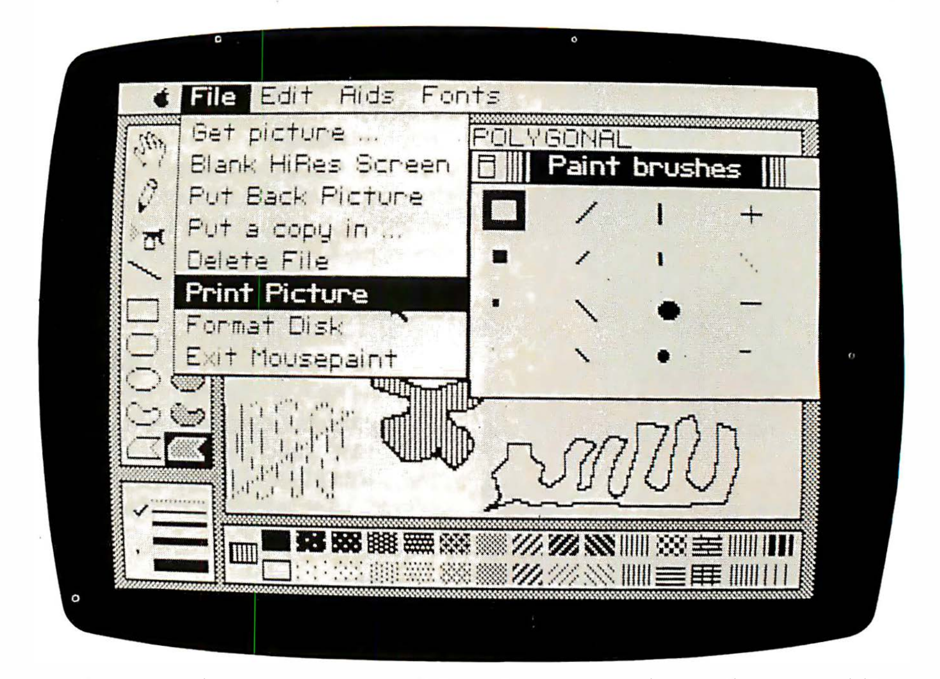


Photo 1: *The file menu has most ProDOS functions except catalog. The long diagonal line demonstrates the limit of polygon sides (63 here). Paint-brush-shapes-palette folder can be moved. The program failed to fill the shape at right, evidently because the 63-side limit was reached. You can print only to Apple's Imagewriter and Dot Matrix printers from this menu.*

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AT A GLANCE

Name
Gibson Light Pen System

Type
High-resolution light pen, interface, and graphics software

Manufacturer
Koala Technologies Corp.
253 Martens Ave.
Mountain View, CA 94040
(800) 227-6703

Price
$249

Author
Steve Gibson

Format
Two 5¼-inch disks, modified Apple DOS 3.3, not copy-protected

Language
Applesoft BASIC, listable and modifiable; machine-language routines callable from BASIC

Computers
64K-byte Apple II + or IIe with Applesoft; hardware works with Apple II compatible or Apple III, but not IIc, and needs at least one disk drive

Documentation
80-page tutorial with entry points for using Pentrak routines in own programs; no schematic

Pi3, and the Amdek 300, for instance. The problem stems not from the color of the phosphor (in fact, it should work on an RGB monitor) but because a steady dot does not dim enough between refresh signals for the cell to distinguish it. Apple's new Monitor II worked only after I increased the brightness greatly, a point that the manual should stress. In fact, sometimes I had to readjust the brightness level during work within the same program.

Some compensations are available in software. Unlike some other annoying light pens, the display does not flicker off and on to allow the pen to read the dots. In most of the Gibson programs, you can invert the color of the cursor to help the pen locate the dot. Often this tracking cursor will stay in place, as the mouse does, when you remove the pen from the screen, and you can also choose x and y lines to help locate the cursor against some backgrounds. A rough-terrain tracking option can be controlled through software.

Calibrating the pen is simpler and more reliable with Gibson's new software.

Using the pen is easy. Just point it at the screen and move it. Unlike the mouse, the pen has no switch, so you have to hit a key to turn drawing on and off or to select the color and some other modes. Gibson makes Pendesigner easy for left-handed people to use by assigning the left and right arrow keys, equivalent to the 1 and 2 keys. Some of the new software uses the space bar to select, but I found most of it will also accept the open-apple key on the IIe.

You don't have to hold the pen tightly to the screen, but if you move it away without turning drawing mode off, when you return the pen to the screen it may draw a straight line between the two points where the pen touched the screen. The mouse does not have this problem. The pen does not appear to scratch the screen. You cannot see the exact pixel you are pointing at because the pen tip covers it. The software makes a "booping" sound to signify that it successfully read the point you selected.

You can run the Gibson software with one disk drive, but a second drive would be helpful to save picture files. The DOS 3.3 on the disk supplied has been modified to boot quickly; you cannot initialize another disk unless you reboot with regular DOS, but you can

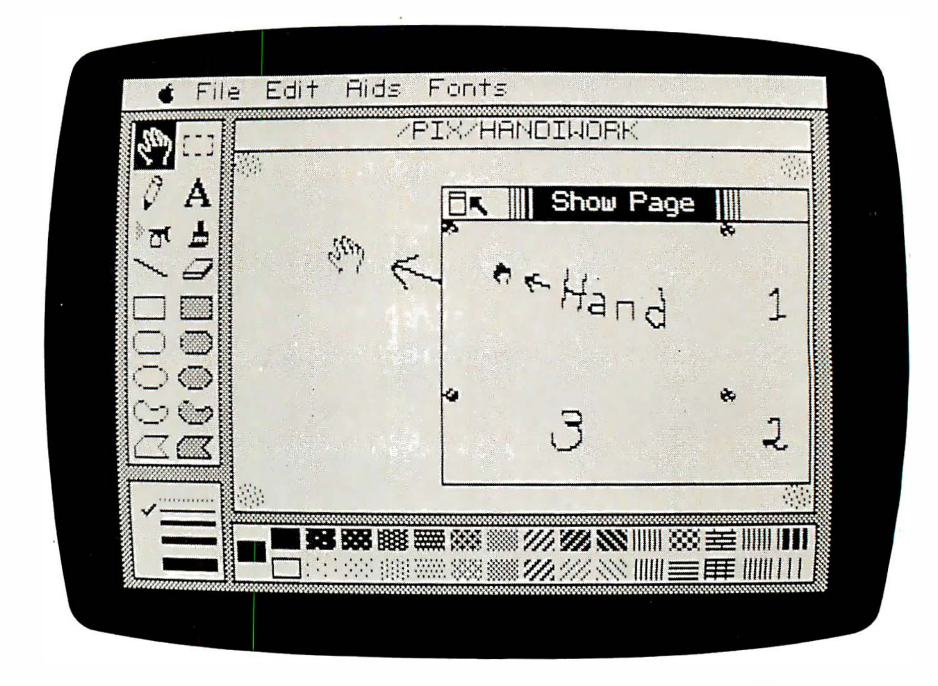


Photo 2: *The grabber hand (drawn on sketch pad here) pushes down on paper to move it so you can work on corners marked 1, 2, and 3 on show-page folder, which shows entire screen page. Note the spray-can pattern at corners of the sketch pad. The cursor arrow points to the put-away icon.*

Critically missing from this version of MousePaint is any way to move a part of the picture from one screen to another.

copy the disks with COPYA and rearrange or modify the programs at will. I was able to use the programs with a disk controller card in slot 4. MousePaint requires you to use slot 6.

The manual doesn't tell you, but the Print function available from the menus is set up to dump the Apple high-resolution screen to a dot-matrix printer through the firmware in just six interface cards: PKASO, Grappler Plus, Microbuffer, Nice Print (Super-MX), Print-It!, and Transtar 315.

As with MousePaint, you can save the picture as a binary file and use another graphics dump program to edit and print it. Adding your own printer driver might be hard because no instructions are provided.

MousePaint Features and Quirks

The MousePaint program stores graphics pages and most of the program in memory and uses Apple's new operating system, ProDOS 1.0.1, so it requires an Apple IIe or IIc or a 64K-byte Apple II or II+. (For an overview of ProDOS, see Rob Moore's software review in the February 1984 BYTE, page 252.) ProDOS is packaged with the new Apple II series disk controllers and for older Apples is sold separately by dealers. It includes a users disk and a nontechnical manual.

When you boot the MousePaint disk, you get a choice of MousePaint or a cute introduction to the mouse and some windowing concepts. In this tutorial you learn nothing about MousePaint itself but only things such as how to slide the mouse around. Movement is jerky in either direction, because, unlike MousePaint, the tutorial is written in BASIC. Next, you learn the results of clicking the mouse button and how to move objects by "dragging" them—clicking on them and holding down the button while you move them. The program provides a little friendly feedback by making a face smile and adding some windows and a door to a house you build by moving shapes. Finally, you learn about pull-down menu bars and put-away icons.

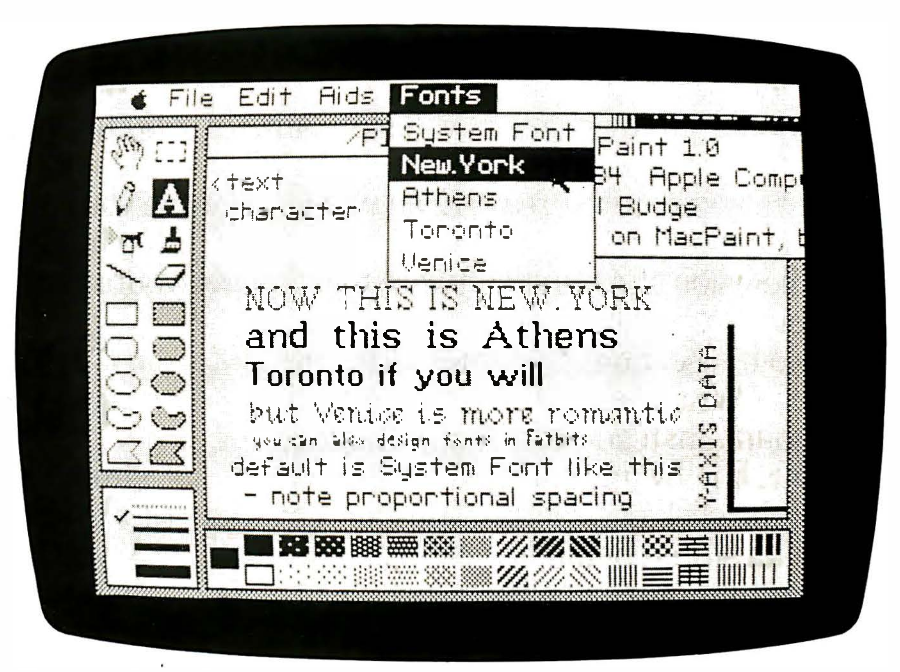


Photo 3: *Besides five built-in fonts, you can pencil in others, even vertically, as here. Note the overlapping windows that demonstrate a Macintosh-like interface.*

At this point I should mention a bug in the windowing in MousePaint. There is little point to moving windows around in this program, but, since you can, you might as well be protected against your stupid mistakes. For example, you can grab a window such as the brush-shapes folder and drag it up far under the MousePaint menu bar. Once you let go of the button, you can't move it back because you can't click on its file bar any longer; the window will always reappear in the same place when you select it, and you must reboot to get rid of it. Accurate clipping would have prevented such nasty tricks.

Even if windowing is not perfect in MousePaint, Budge's achievement at transferring some of Lisa's graphics and mouse technology to this 8-bit computer is surely one of the most exciting programming feats I have seen.

When you enter MousePaint, you see only a sketchpad without "paper" on it. If you want to use a tool, you must first get some paper, either by selecting Blank HiRes Screen (contrary to what the manual states, you are not offered a choice of blank screens), or by Getting an existing file from a disk. Either choice is available by pulling down the file menu and releasing the button when the choice is displayed in inverse.

There is a sample picture on the MousePaint disk, an engineering drawing of an AppleMouse, but since the manual doesn't mention it and you can't get a catalog from the program, you wouldn't find it unless I told you its filename is /MOUSE.PIC. As you become more experienced, you should initially Copy the blank screen to a disk or RAM disk file and during the session frequently Put Back the picture. That way, if you make a mistake you cannot Undo (limited to only a single step), you can Get an earlier version of the picture.

The grabbing hand ("grabber") (photo 2) is necessary because the sketch pad displays only a part of your paper at once, obviously because the icon frame takes up part of the screen. The high-resolution screen is much smaller than a full page of real paper, and there is no way to link screens so they fill a page when printed. You need to push down

(continued)

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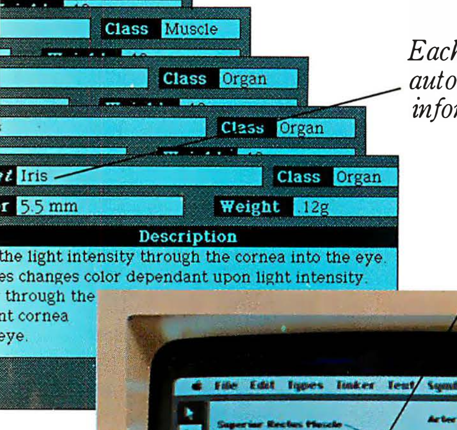
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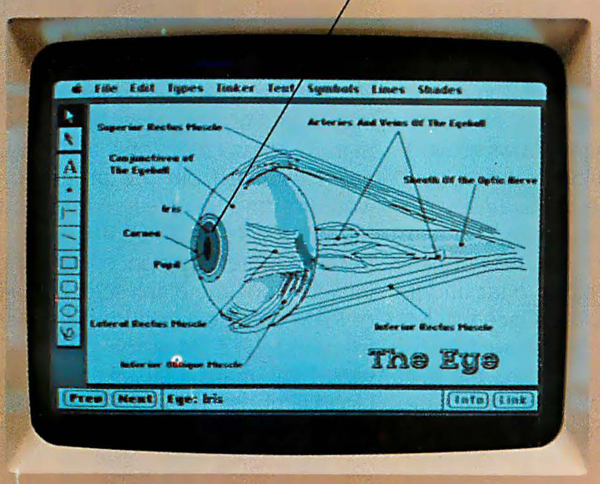
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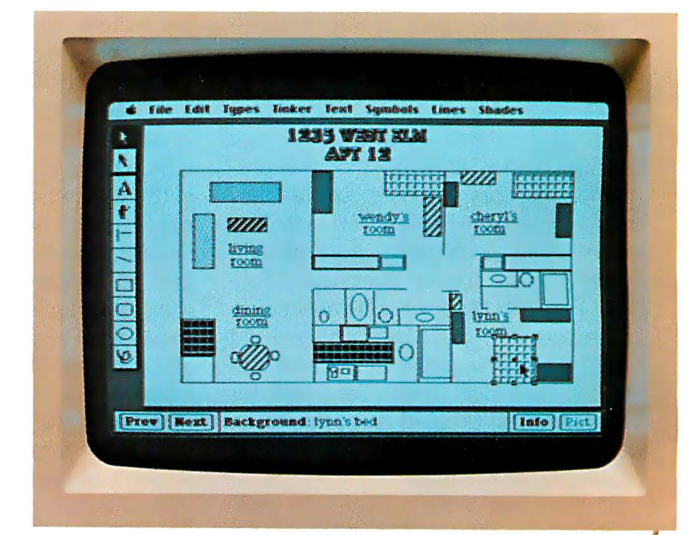
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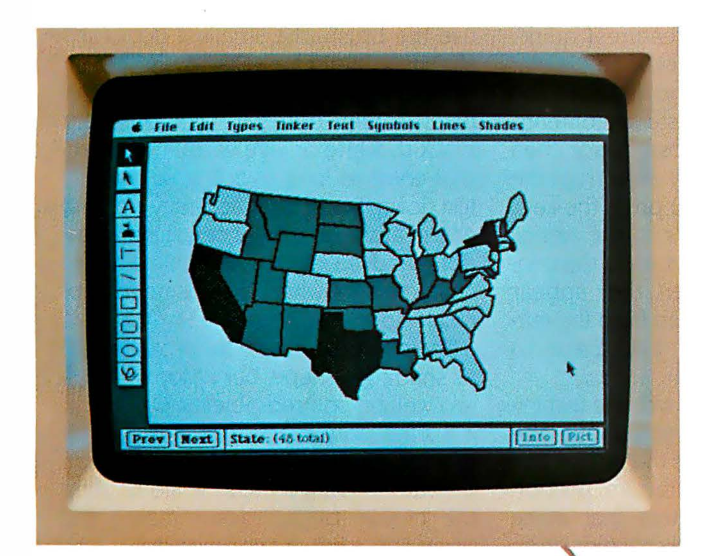
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Filevision can help you quickly make maps, and dawdle over the demographics. Assemble anatomical drawings and look up the names of the ligaments. Separate a plan of Bar Mitzvah guests into those who do and those who don't eat Kosher food and actually see who you seat them next to. Pinpoint places and connect them to faces. Control your inventory by depicting your entire shelf space. And map out geography lessons, sales territories and direct-mail ad targets ad infinitum.

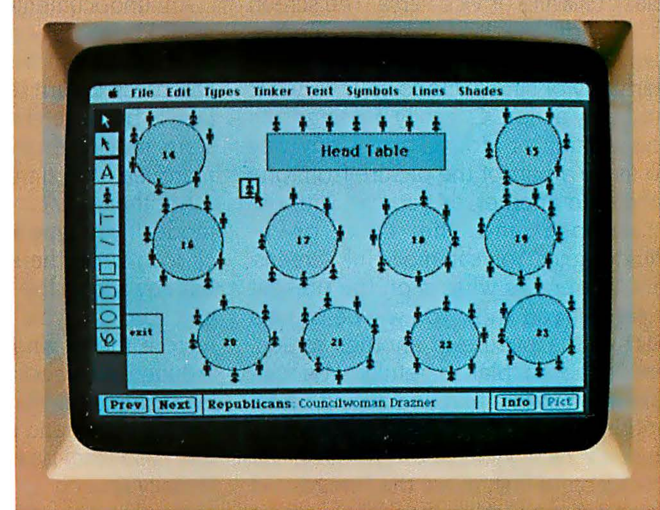
Filevision. The unique filing system for your Macintosh that lets you store and work with information in pictures, as well as numbers and text.

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Plan a political fund-raiser with Filevision, and seat the non-smoking Independents away from the smoking Republicans. Or, click to see which blocks of seats have been reserved at your dinner theater.

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on the hand to slide each of the four corners of the MousePaint page into view, where you can work on them. This can be tiresome in the Fatbits (zoom) mode, since Fatbits (unlike Pendesigner's zoom) always comes up showing the upper left-hand corner of the paper and it takes a dozen full travel slidings of the mouse to reach the opposite corner. There is no shortcut to change icons as in MacPaint or Pendesigner, by simultaneously pushing down a key and the mouse button, so you have to click an icon each time you want another tool such as the hand or pencil.

The editor's box ("marquee") selects an area on which you can operate with any of the procedures in the Edit menu. You can also pick up the outlined area and drag it elsewhere on the visible paper. I would have appreciated a lasso tool like MacPaint's, which, instead of a rectangle, fits tightly around the shape. Likewise, if you frame something and move it or paste it elsewhere and then undo it, MousePaint will leave a hole at the location rather than restore the background.

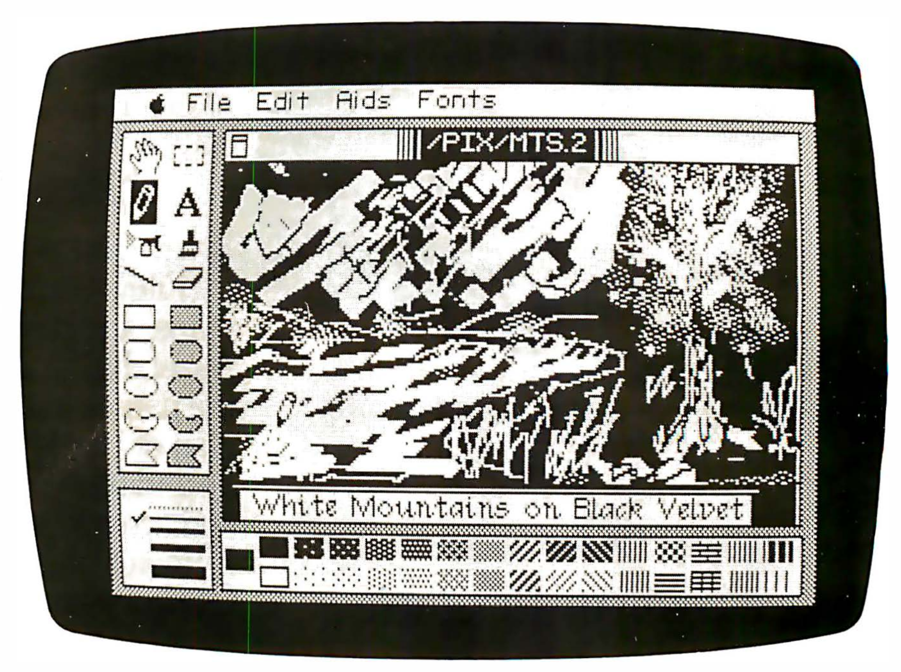


Photo 4: *I used the diagonal brush shape for the mountains and reflection, spray can for apple tree, and pencil for snowy crevasses, then inverted the whole sketch pad. Note the pencil in Echo Lake.*

In the edit mode you have many choices: you can Cut to a buffer, Paste what is in the the buffer, Copy to buffer without cutting, Delete without putting into the buffer, or Invert pixels from black to white or vice versa. The screen is already inverted for your convenience. You can also Flip horizontally or vertically or simply Undo your very last and only action. Critically missing from this version of MousePaint is any way to move a part of the picture from one screen to another, as you can with the Macintosh and the Lisa, or in Pendesigner. You can move full screens, but that erases what is on the present screen. If you know you will be using a part of the picture in another screen, you need to plan carefully. You can erase all but that part and copy it under another name, then start off with it as the new picture. You have to make the background first, move the foreground in, and then touch up the messy corners with Fatbits.

A small note in the manual points out what might be confusing if you run into it in the midst of editing: since the character fonts and screen buffer occupy the same memory area, choosing a font from the pull-down menu right after editing will destroy the edit-buffer contents. You won't even get the pointing hand icon if you then select Paste, but must Copy the frame again. The manual says you'll receive a warning before the buffer is destroyed, but I didn't.

An undocumented feature ("quirk" would be more accurate) of edit is that while you are moving the marquee you can press Return to paste its contents. Don't, because the cross cursor then starts moving erratically away from the marquee each time you press the key.

Another quirk occurs in the pencil mode. If you type letters while the pencil icon is on the screen, they appear halfway across the screen from the cursor. Luckily, you can backspace to restore the original.

Budge did a good job with the text letter command. When you move the bracket cursor and press the mouse button, you can type attractive proportionally-spaced characters that erase correctly when you backspace or press the IIe delete key. When you press Return, the text continues on the next line down, but text won't automatically word-wrap and you can't get enough characters on the screen to make MousePaint a word processor. MousePaint has four fonts in different sizes (their names correspond to Macintosh fonts), but you cannot change styles or sizes as in MacPaint.

The pencil tool is one I tend to use the most in MousePaint. It does not work exactly as you might expect, though. To draw a black line, you should use the brush (the smallest dot brush shape is the same size as the pencil point). The pencil instead inverts the pixel (screen dot) you click on, from black to white or vice versa, then stays that color as long as you hold the button down. For greater accuracy, you can enter Fatbits mode and pencil individual dots, and so construct small or large characters for which there is no font, or clean up messy details.

The spray can is nice for projects such as shading a shape, but it doesn't work too well on colored objects. Ordinarily, it sprays only black, but if the background is colored, the appearance can be odd. Moving the can while holding the mouse button down makes the spray come out every seven dots or so and prevents the background from becoming solid black.

If you are using a color monitor or television, you will probably use the filled and unfilled shape tools much more than I did, because they are the

(continued on page A62)

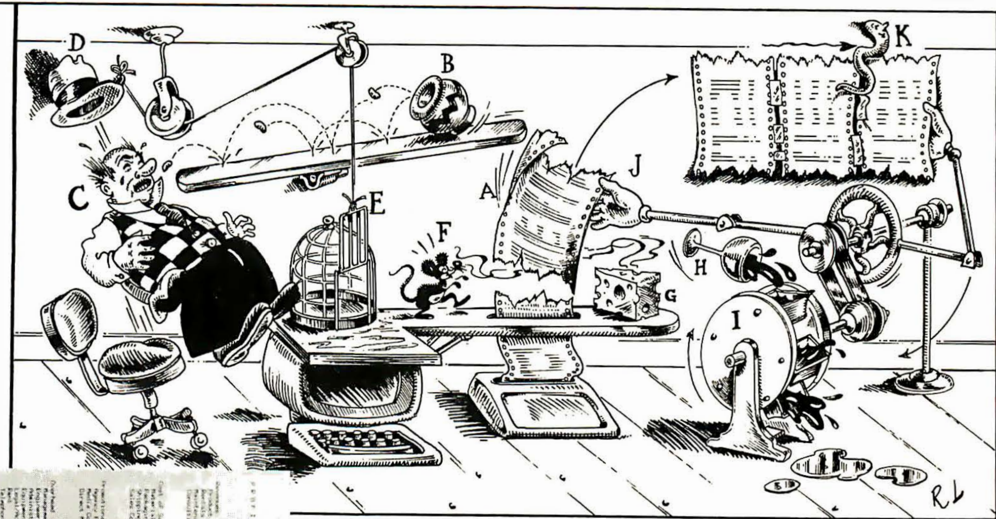


RISING SPREADSHEET (A) KNOCKS MEXICAN JUMPING BEANS (B) INTO MOUTH OF NEUROTIC MAN (C) WHO IS SO DISCOMBOBULATED THAT HIS HAIR STANDS ON END, DISLODGING HAT (D) WHICH OPENS CAGE (E) AND RELEASES EPICUREAN MOUSE (F).

MOUSE, INSPIRED BY SCENT OF PERFECTLY AGED CAMEMBERT CHEESE, GNAWS THROUGH SPREADSHEET, ONLY TO DISCOVER HE HAS BEEN FOOLED BY AROMA OF OVER-RIPE GORGONZOLA (G).

IN A FIT OF PIQUE HE SPILLS VINTAGE WINE (H) INTO WATERWHEEL (I) WHICH TURNS PULLEY THAT CAUSES GLOVE (J) TO GRASP SPREADSHEET AND MOVE IT TO TAPING AREA.

SHEET IS TAPED SECURELY IN PLACE BY TRAINED ADHESIVE TAPE WORM (K).



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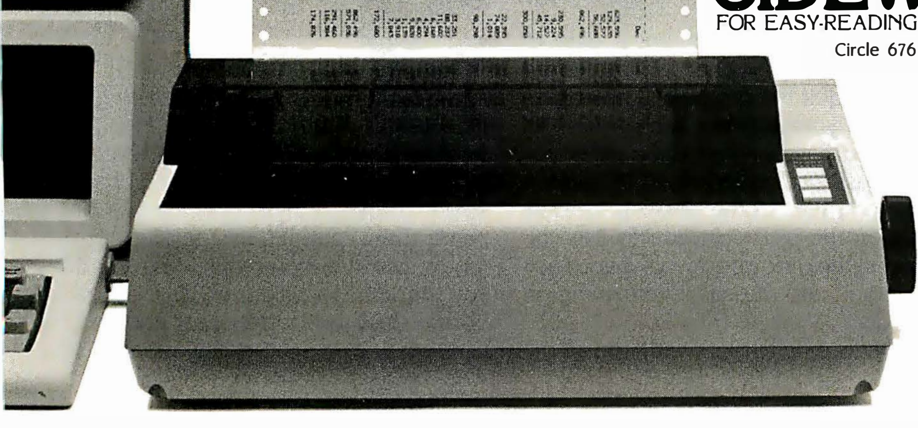
The experts agree. *PC* Magazine, for example, writes: "If you've got the need, Sideways has the solution." And *PC World* calls Sideways "nifty . . . . an easy to use program that does what it claims."

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BY KAREN A. CMAR

APPLEWORKS: AN INTEGRATED OFFICE PRODUCT

Word processing, database management, and spreadsheet analysis in one package for the Apple IIe and Apple IIc

Appleworks is the first package developed for the Apple IIe and IIc that combines the three most popular software applications: word processing, database management, and spreadsheet analysis. Though the software design of the individual modules is not innovative, Apple Computer has produced a package that is easy to learn, genuinely user-friendly, and well documented.

Like the Lisa and the Macintosh, Appleworks uses the kind of everyday language that the inexperienced computer user can understand. The Appleworks "desktop" can handle more than one file at a time. Each file is "added to the desktop" and as many as 12 files can be on the desk at one time. The concepts of "cut and paste" and of a "clipboard" are used to help the user pull information from one file and transfer it to another.

Appleworks requires an 80-column text card (preferably with extended memory), a monitor, and one disk drive. A printer is not necessary, but the system would not be very useful without it. Appleworks is set up to run with any of eight different printers (the Apple daisy-wheel printer, Apple Silentype, Apple Imagewriter, Epson MX, RX, or FX, and the Qume Sprint 5 or 11) and can be customized to run with any other printer. The user can specify as many as three printers.

Appleworks can also be used with a Profile hard disk.

The Appleworks package comes with five single-sided disks, including two training disks, a start-up disk, a program disk, a sample files disk, and a 280-page manual, which includes a written tutorial. The training disks include several quizzes, lots of good graphics, and a few bad jokes. On the whole, the training disks and the tutorial are excellent.

Appleworks will automatically calculate the page breaks each time you print a file.

There are two basic modes in the Appleworks program. The highest level, which is the main menu, does the work of controlling the files on the desktop. From the main menu you can choose to add files to the desktop, remove files from the desktop, save files, or quit the program. You can choose the "Other Activities Menu," which includes commands for formatting disks and changing the disk and printer setups, or you can choose to work with one of the files on the desktop.

This part of the program is easy to use, especially the Quit routine. Before you can quit the program, Appleworks reminds you to save each of the files that you have altered during the session. Also, each time you ask for a directory, add files to the desktop, or save files on the disk, Appleworks lists the files on the disk, how much space each occupies, and the space remaining on the disk.

By choosing to work with one of the files on the desktop, you enter the second level of the program, the review/add/change mode. This is the mode in which all other functions are performed, including setting up file structures, inputting information, and developing report formats.

A Help screen can be called from various other menus. It lists all the commands and command codes that can be called from the current menu. Unfortunately, the Help screen lists only the Appleworks commands and the codes for issuing the commands. Considering the fact that the package is oriented toward the less experienced user, it might have been helpful to put in some additional instructions for some of the more complicated commands.

The screen layout is one of the nicest features of Appleworks. The main menu appears as an index card on the screen. Each selection (except when you are actually working with one of the files) appears as another index card.

Appleworks never leaves you wondering what is happening. There is always a message on the screen to tell you what to do. Even error messages are handled well by the program. Errors are handled within the program in Appleworks terminology, and it is usually easy to recover and get back to what you were doing.

The top and bottom lines of the screen contain basically the same information regardless of whether you are working with a spreadsheet, a database, or a word-processing file. The top of the screen displays the name of the file, the name of the current menu or command mode, and the menu you will go to if you press the Escape key. This is an important feature for the inexperienced user who often gets lost in a maze of

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multiple-level menus.

The bottom of the screen shows a prompt that tells you what to do next and, in the lower-right corner, displays a reminder on how to call up the Help screen.

All commands are issued by holding down the Open Apple (OA) key and typing a single letter.

Word Processing

The word-processing module is my favorite part of this package. (In fact, I like it so much, I'm using it to write this article.)

To enter the word-processing module, you simply choose to work with an existing word-processing file or create a word-processing file. Then you may begin to type information into the file or use any of the Appleworks word-processing commands. In addition to files created by Appleworks, you can edit text files created by other word processors (provided they are on ProDOS-formatted disks).

Like most other word processors, it has word wraparound, and the Return key indicates the end of the paragraph or a blank line. Unlike some other word processors, Appleworks' word wraparound responds immediately (and quickly) to any changes in a paragraph.

Cursor scrolling speed with Appleworks is excellent (see table 1). The commands for moving the cursor around the document are adequate but not designed for serious word processing (i.e., someone who sits at the terminal all day might find both the cursor control and the DELETE commands somewhat inadequate).

The cursor can be moved one space at a time using the four arrow keys (up, down, left, and right). By holding down the Open Apple key with the left or right arrow keys, you can move the cursor one word to the left or right. The Tab key and the OA-Tab key combination can be used to move across a line either forward or backward. (The tabs can be reset using the OA-T command.) These commands for horizontal movement are certainly adequate, but I missed the ability to move from one end of a line to the other with one keystroke.

For vertical movement, there is the "ruler," which allows you to hold down the Open Apple key and type a number between 1 and 9. The number 1 will bring you to the beginning of the document, the number 9 will bring you to the end, and the numbers in between will move the cursor proportionately within the document.

The OA-D command allows you to use the arrow keys to highlight blocks of text you want to delete. When you press Enter, the text disappears and the paragraph is reformatted. This highlighting feature (reminiscent of Lotus 1-2-3) is excellent in that it really does help prevent mistakes, but like most packages, Appleworks has no prompt to confirm that you want to delete a block of text and (sadly) no buffer that holds deleted text. Once deleted, the text is lost.

The only other delete command, Control-Y, deletes the entire line to the right of the cursor.

The MOVE and COPY commands are similar to the OA-D command. You simply highlight the area you want to move, press Enter, move to the place where you want the text to begin, and press Enter again.

Appleworks has two cursors: an insert cursor, which is a blinking bar, and an overstrike cursor, which is a blinking rectangle. The command OA-E (E is for Edit) switches between the two cursors. To insert text you move one character to the right of where you want the text inserted and type using the insert cursor.

Appleworks' word processor has a Find/Replace feature that can distinguish between upper- and lowercase letters, or it can ignore whether the text is upper- or lowercase. This is an excellent feature that most word processors don't have. The FIND/REPLACE command works from the current cursor location to the end of the text and will not go backwards.

One other helpful feature of Appleworks' word processor, which also works in the other two modules, is the HARDCOPY command (OA-H). This command will print out whatever is currently on the screen. The HARDCOPY command also works in the main menu mode.

Formatting and Printing Word-Processor Files

In addition to the basic formatting features, Appleworks also has some really useful special formatting features. One of my favorites is the INDENT command, which allows you to set up hanging paragraphs or bulleted items. Others allow you to underline, put text into boldface type, make superscripts and subscripts with just a few keystrokes. These features, as well as the other Appleworks print options, simply require you to move your cursor to wherever you want the print option to begin and type OA-O (O for options). A menu of all the print options appears, and it is simple to follow the prompts to specify the details of a print option. When you are finished, you press the Escape key to return to the text.

The pagination features are also very well thought out. Appleworks will automatically calculate the page breaks each time you print a file. At any time, you can calculate where the page breaks will occur by using the OA-K command (K is for calculate?). The page breaks will appear on the screen as dotted lines with the words "end of page" and the page number in the center. Appleworks has its own rules for setting up pages. (For example, it won't break a paragraph so that only one line is split from the rest of the paragraph—a great idea!) You can override Appleworks page breaks in two different ways. First, you can specify groups of information that must remain together on the same page, and second, you can actually set up some or all of the pages yourself. These are wonderful features, which you'll undoubtedly appreciate if you've ever tried to lay out pages by counting line numbers.

In addition to linking groups of information together on the same page, you can link groups of words or characters together on the same line using "sticky spaces." To insert a "sticky space" in the text, you just type OA-SPACE.

Another useful feature is the ability to specify the number of copies you want printed. You can also have a document stop during printing at a certain point so that you can enter information from the keyboard. These two features together allow you to print out personalized letters.

Things that you might find missing from this package are the ability to set up several files to automatically print sequentially and a spelling checker. It also lacks the ability to do mail-merge. Over-

(continued)

AT A GLANCE

Name
Appleworks

Manufacturer
Apple Computer Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010

Type
Integrated software package including word processing, spreadsheet analysis, and database management

Format
5¼-inch floppy disk

Hardware Needed
Apple IIe or Apple IIc; requires 80-column board

Operating System
ProDOS

Price
$250

Documentation
280-page manual, tutorial disk, sample file disk

Audience
General

all, though, it is an impressive word-processing package, especially for those who have no previous experience with word processing.

MANAGING DATA

The Appleworks database module is a very simple system designed to handle mailing lists, schedules, and simple data files, but not suitable for complex business database applications. Its greatest asset is its ability to interface with Appleworks' word-processing and spreadsheet programs.

It is capable of handling text or ASCII (American Standard Code for Information Interchange) files, DIF (Data Interchange Format) files found in VisiCalc, Apple's own Quick File files, and, of course, files created from scratch by the Appleworks' database. It can also create DIF files. According to the documentation, each Appleworks database file can hold approximately 250 records when using an Apple with 64K bytes of RAM (850 with 128K bytes), and each record can contain as many as 30 fields (referred to as categories). The maximum record length is 1024 characters, and the maximum entry length is 76 characters.

Creating and working with a database file are basically easy, but the clarity of the documentation in the manual and in the tutorial is not as good as for the word-processing and spreadsheet modules. The on-screen prompts are sometimes unclear. For example, when you're creating a file, a screen appears called the Change Name/Category screen. The right side of the screen lists some of the options, but the instructions are unclear. The left side of the screen says "Category 1" with the insert cursor blinking at the beginning of the word "Category." In actuality what you must do is type the first category name over the words "Category 1" using the overstrike cursor, then press Return. You continue typing the category names in and pressing Return after each (the words Category 2, Category 3, etc., never appear on the screen). When you have finished with all categories you must press the Escape key to get out of this sequence. It is hard to figure out how to go through these steps from the instructions on the screen. The instructions in the manual are somewhat clearer.

After you have created a file, Appleworks prompts you to input data. There are two screen display formats for data in Appleworks' database: the Single Record Layout, which displays all of the information contained in one record with categories listed vertically, and the Multiple Record Layout, which displays all the records in the file with categories listed horizontally. You can switch back and forth between the two formats using the OA-Z (ZOOM) command. In Multiple Record layout, if all the categories won't fit across the screen, you can specify which categories you wish to have displayed and how wide the columns should appear on the screen using the OA-L (LAYOUT) command. Unfortunately, however, there is no way to scroll over to the right to see the missing categories. This is a serious drawback when you're using the Multiple Record Layout to input or change data.

The editing features and methods of moving the cursor are basically the same as in the other two modules. You can change the file structure by going back into the Change/Add Name screen with the NAME command (OA-N). Using

Table 1: *Benchmark tests for word processing and spreadsheet calculations. All tests run on the Apple IIe with 128K bytes of memory.*

Test*	Appleworks' Time (seconds)
Word Processing	
Document Load	14.3
Document Save	19.7
Search	3.5
Scroll	27.7
Spreadsheet	
Save	18.7
Load	18.3
Recalculate	18.0

*Note: Word-processing times are based on Appleworks' loading, saving, searching, and scrolling a 4000-word document. The spreadsheet consists of a 25- by 25-cell matrix. Each cell in the matrix is equal to 1.001 times the cell to the left. The width of each cell is 10 characters. The BYTE database test was too large for Appleworks. The standard database consists of 1000 records, each record consisting of 100 characters.

this screen you can add categories, delete categories, move categories, or change category names. You can insert records in the file by using the INSERT (OA-I) command.

Appleworks' database has some simple sorting functions. You can select records to be displayed on the screen or printed out using the SELECT RECORDS (OA-R) command. The criteria are expressed in an easy-to-learn format, and it is menu-driven so there aren't any problems with syntax. For example, to select from a mailing list, you could specify "State equals Massachusetts and Last Name begins with A through C." Each word in these selection specifications is chosen from a menu except the letters "A" and "C," so it's hard to make a mistake. The reference manual doesn't explain the selection criteria very well, but the on-screen prompts are good.

The SELECT RECORDS command changes the way a file is displayed on the screen (and printed out) but doesn't actually change the contents of the file. You can also use the ARRANGE command (OA-A), which sorts the file and permanently changes the order of the records. You can arrange records in numerical or alphabetical order, either lowest to highest or highest to lowest. You can sort on only one field at a time, so you have to perform multiple sorts if you need the file sorted on more than one criterion.

There is a FIND command (OA-F) in Appleworks' database, but no REPLACE command. I wonder why not, as this is a frequently used feature of most database-management systems.

Appleworks has a built-in report generator, which allows you to generate reports from your data files that can be displayed on the screen, printed out, or "cut and pasted" into a word-processing file.

The report generator provides two basic report layouts: a table-style report and a label-style report. In both formats you have an opportunity to choose which categories you want displayed and how you want them displayed.

You can save your report formats for later use and build more than one report format for a given file. However, if you change the file structure by adding a category, deleting a category, or moving categories, you lose all of your

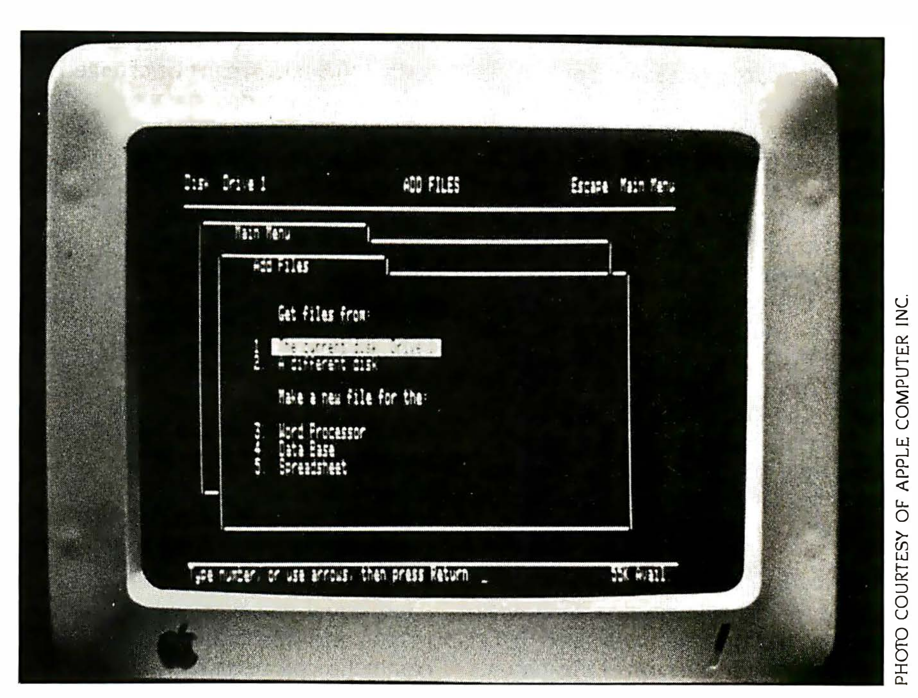


PHOTO COURTESY OF APPLE COMPUTER INC.

Photo 1: *Appleworks offers users screen menus that are on index card images.*

report formats. Presumably, this is a necessary safeguard, but it would be nice to be able to amend report formats or handle these changes in a less drastic fashion.

The CALCULATE command (OA-K) allows you to add a maximum of three calculated fields to your file as part of a report format. There are no sophisticated arithmetic, logical, or statistical functions, only addition, subtraction, multiplication, and division. Formulas for calculated fields refer to categories by the letters that appear on the screen at the top of each column. This is an excellent feature, but its usefulness is severely limited by the fact that you cannot sort or select records from files based on calculated fields.

Totals can be set up for all numeric categories, including calculated categories, using the TOTALS command (OA-T). Subtotals can be set up using the GROUP TOTALS command (OA-G). This is perhaps the most poorly documented command in the entire package.

The actual printouts of the reports are rather unattractive and difficult to read. The filename, report title, and report heading appear on successive lines at the top, and the body of the report begins immediately on the next line. This makes it look crowded. Blank lines can be added to a tabular report only by adding blank fields to the file. Dotted lines and underlines cannot be added at all.

There are very few print options in the database module. You can't use boldface, condensed type, or many of the other features that are available in the word-processing module. Of course, you can convert any database report into a word-processing file by using the "cut and paste" feature, and then you can use all of the word-processing features to reformat the report. But you can't save the revised format for reuse with different data, and you can't add data to it just by adding to your database file.

Another item I disliked about the Report formats is that the total line and subtotal lines are not labeled. Appleworks does not automatically put the word "Total" on the total line, nor does it give you the opportunity to do so or to choose a label yourself. Also, there is no underline separating the entries in the column from the total. This further contributes to the crowded appearance of the reports. Again, all of this can be fixed by moving the report to a word-processing file, but this is not an ideal solution. These problems make it cumbersome to use Appleworks to create professional-looking business reports.

(continued)

I found several bugs in the database portion of the program. When you are in the process of creating report formats, the OA-Z (ZOOM) command is supposed to allow you to zoom in to the actual records and move around through the file. I was unable to get it to work. The OA-V command supposedly eliminates category names from report formats. Again, I could not make it work. The MOVE command (OA-M) also didn't work properly. I was able to move records anywhere in the file but not to the end of the file. Also, if you right-justify a category in the report format, then set up a total for that category, but later decide to eliminate the total, you lose the right-justification also.

THE SPREADSHEET

The spreadsheet module is a well-thought-out package with fairly good documentation. It has all of the features of VisiCalc (except some arithmetic functions) plus useful extras.

The Appleworks spreadsheet is 127 columns by 999 rows. If you use an Apple with 64K bytes of RAM (random-access read/write memory) you should be able to fill about 1800 cells, and with 128K bytes you should be able to fill about 6000 cells (according to the documentation). You can start spreadsheet files from scratch or use the Appleworks spreadsheet module to process VisiCalc's DIF files.

Appleworks' commands for formatting the worksheet display are much like those in other spreadsheet packages. Commands that affect the display format of the entire worksheet are referred to as "Worksheet Standard Values." There are Worksheet Standard Values for value formats, label formats, protection, column widths, and recalculation. Value formats can be set up to display the values on the worksheet as fixed decimals (one to seven places), as dollars (two decimal places and a dollar sign preceding the number), with commas (commas between thousands), or as percents. Label formats can be left-justified, right-justified, or centered. Column widths can be from 2 to 75 characters and can be changed for individual columns or for the whole worksheet. You can recalculate the worksheet manually or automatically, by columns or rows.

The protection feature allows you to protect label cells, value cells, or all cells so that the entries can't be changed accidentally by you or someone else using your worksheet, an important feature if you use a spreadsheet program to set up templates that are frequently reused.

One really excellent Appleworks feature is the ability to check all of the Worksheet Standard Values currently in effect. By calling up the Help screen and scrolling down to the bottom of the command listing, you see a listing that looks like this:

Current Settings of Standard Values	
Protection is	On
Label format is	Left-Justify
Value format is	Appropriate
Frequency is	Automatic
Order is	Columns

Individual cell displays can be formatted also. The CELL LAYOUT (OA-L) command can be used to change the display characteristics of a cell or range of cells. The choices are basically the same as for the worksheet formatting, and individual cell layouts override the format of the worksheet.

As in the other modules, using your cursor to highlight the appropriate area, you can insert, move, delete, or copy a cell or range of cells.

As with many spreadsheet programs, the COPY command becomes complicated because formulas that refer to other cells in the worksheet have to be specified as either "relative" to their new positions in the worksheet or "no change."

Other commands let you split the worksheet into two windows (OA-W) with either synchronized or unsynchronized scrolling, set up fixed titles (OA-T), and blank out cells or ranges of cells (OA-B).

The Appleworks spreadsheet module has very few arithmetic, financial, and logical functions. Arithmetic functions are limited to sum, maximum value, minimum value, integer value, absolute value, square root, average, count, and "choose" (chooses one of several values based on the first value in its list of arguments). There is also a Lookup function, which finds a value in a table and returns a second value that corresponds to the first. Appleworks has only one financial function, namely, Net Present Value, and the only logical function is IF. The lack of financial functions and logical functions (like AND, OR, NOT, ELSE) is a serious hindrance to using Appleworks for complex business models.

The spreadsheet module, like the database module, has very limited print options. Of course (as mentioned in relation to the database printouts), you can transfer your spreadsheet to a word-processing file and use any of the word-processing features.

The Appleworks spreadsheet has a sort function that is basically the same as the sort function in the database module. The ARRANGE command (OA-A) lets you sort your worksheet according to the value of entries in a particular column or row. Sorting can be alphabetical from A to Z or from Z to A, or numerical from lowest to highest or from highest to lowest. You can also search for a specific piece of information using the FIND command (OA-F). The FIND command will search for any combination of up to 25 characters. In the spreadsheet module, the FIND command is not case-sensitive, and you cannot search for numeric values. The FIND command can also be used to move the cursor to a specific cell address.

One unusual feature of the Appleworks spreadsheet is that after you use a command, the spreadsheet reprints on the screen, one line at a time from the top. I found this distracting and time consuming. Another feature that I did like, however, is that while the worksheet is recalculating, the screen tells you which column or row is currently being calculated.

The spreadsheet module on the whole is well documented and simple to learn. It doesn't have some of the functions and features that can be found in the latest generation of spreadsheet programs, but it does have most of the features that users demand and a command structure and documentation package that is easy to use.

OVERVIEW

Appleworks is a well-integrated package. The spreadsheet and database are good but certainly not standouts in the marketplace. The word processor is well above average but still has room for some improvement. As a package, however, especially for those new to computing or those whose needs are personal rather than professional, Appleworks is excellent. ■

PRESHIFT-TABLE GRAPHICS ON YOUR APPLE

This fast assembly-language routine allows you to move rectangular images quickly to any point on the Apple high-resolution graphics screen

BY BILL BUDGE, WITH GREGG WILLIAMS AND ROB MOORE

[Editor's note: *This article was a collaborative effort.* Bill Budge *shared his implementation of preshift-table graphics with us and helped* Rob Moore *and me with the article itself.* Rob *wrote the assembly-language subroutine, and I wrote the article text and* BASIC *program. . . .*G.W.]

In microcomputer graphics, speed is always of the essence—we are always trying to get the same processor to do more work than it's done before. In creating Mousepaint (a drawing program that uses icons, windows, and Apple's new mouse), Bill Budge devised a technique that simplifies moving rectangular blocks of pixels on the Apple II high-resolution graphics screen. The cost is a slight loss in speed and an overhead of about 3K bytes of memory, but the versatility of this routine certainly justifies the expense.

Expressed simply, Budge's method (called *preshift-table lookup*) uses a short assembly-language routine to access a large table that lists all the possible shifted results for all possible byte values. This saves time by exchanging a certain amount of calculation, looping, and shifting with a single table lookup, a logical OR operation, and some occasional set-up instructions.

APPLE II HI-RES GRAPHICS

The Apple high-resolution graphics page is organized as 192 lines of 280 dots each; you will have this resolution available to you if you view the page on a monochrome display. If you use a color display, certain two-dot patterns will appear as a single color dot; this means that your effective resolution for color graphics is 140 by 192 dots. The high-resolution page can display six colors: black, white, violet, green, orange, and blue. Each line of graphics occupies 40 bytes in memory; given 280 dots per line, this means that each byte converts to 280/40 (or 7) dots per byte.

The fact that each byte of memory translates to 7 (not 8) dots—3½ if you're talking about high-resolution color—is one of the many subtleties that characterize Apple graphics. Speaking in terms of the color display of dots within a byte, you can display black, white, and one of two sets of two colors each—green/violet or orange/blue. The computer interprets the most significant bit of a byte (the only one that doesn't translate to a dot) as a color bit; when this bit is off, you can get green/violet, and when it is on, you can get orange/blue. Two adjacent bits on—anywhere in the byte—make a white dot appear. Two adjacent bits off make a black dot. A

(continued)

Bill Budge is well-known for his graphics work on the Apple II; his best-known products are Raster Blaster (the first pinball game of its caliber), Pinball Construction Kit, and MousePaint (supplied with the Apple II mouse). Gregg Williams is a senior technical editor at BYTE. *Rob Moore is a hardware designer and a frequent contributor to* BYTE. *They can be reached at* POB 372, Hancock, NH 03449.

single even bit on (with both adjacent bits off) makes a violet or blue dot, depending on the color bit. Similarly, a single odd bit on makes a green or orange dot. See figure 1 for details. (Because the even/odd position of a bit within a byte determines its color, images to be viewed on a color display must move an even number of bits at a time. If they don't, they will alternate between the two color sets every move.)

One final detail: if you consider the byte as a binary number, you must strip off the most significant bit and reverse the order of the remaining bits before you put them on the high-resolution screen—in other words, the rightmost bit in the byte becomes the leftmost dot on screen, and vice versa. Figure 2 shows this relationship. In this article, we will be shifting rectangular blocks of dots to the right. Because of the above relationship, this means we will be shifting bits to the *left*. Keep the following sentence in mind: *to shift dots right, shift bits left*.

Finally, we get to the overall makeup of the high-resolution screen. With seven dots per byte, 40 consecutive bytes become 140 color dots (or 280 monochrome dots). But do the next 40 bytes make up the next row of dots? Unfortunately, no—they are the 65th row. As you can see from figure 3, consecutive rows of dots are not 40 bytes apart. The scheme is much more complex than figure 3 shows, but that is of little interest to most programmers. Because speed is of the essence in graphics work, most graphics routines look up the address of the first byte in a row from a table of 192 values instead of having the computer calculate it while it is doing the graphics. Once we create that table, as the program in listing 1 does, the complexity of the high-resolution screen layout becomes irrelevant.

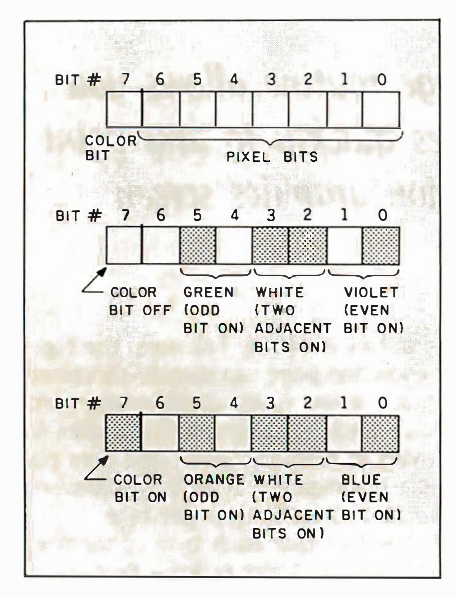


Figure 1: *Translating memory bits to graphics on the Apple high-resolution graphics page. Only 7 of the 8 bits in a byte become dots on the high-resolution screen. Bit 7 determines what colors can appear in that byte.*

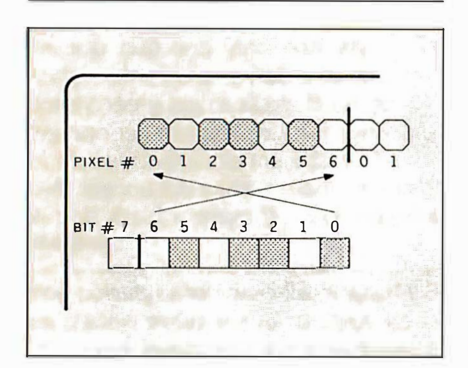


Figure 2: *The relationship between bits and pixels. The Apple II reverses the seven low-order bits of a byte before displaying them on the high-resolution screen—that is, it displays the bits right to left.*

Preshift-Table Lookup vs. Preshifted Shapes

Most people who do high-performance work with Apple II graphics know about *preshifted shapes*, a graphics method that stores seven versions of a given image and quickly looks up the appropriate one. (For more details, see the text box "What Are Preshifted Shapes?" on page A26.) Preshifted shapes have one main use: to allow rapid animation of small shapes that move only several dots at a time. Budge's needs were different: he had several windows that he had to be able to move quickly. Such windows are too large to have seven versions of (or modify seven versions of). In addition, their expected movements were large jumps across the screen, not continuous movement.

Shifting an image does not change it visibly, but it does change how that image is represented in byte-sized pieces. For example, the simple two-byte image in figure 4a changes significantly when shifted right three dots—what's more, we now need another byte to store it in! Notice that some dots stay in the same seven-dot group (these are called "shiftstay" dots) and that others move

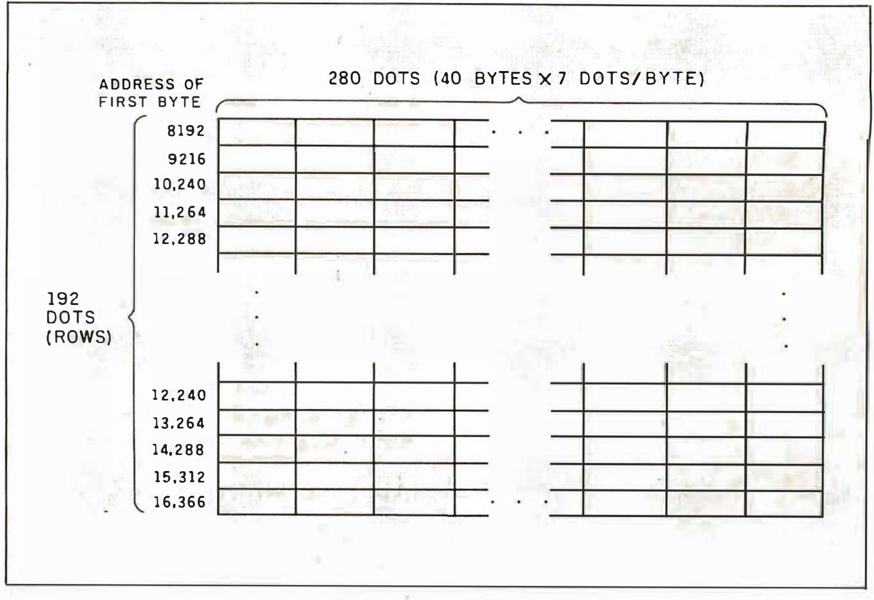


Figure 3: *The Apple II high-resolution graphics page. Each line of dots is given by a contiguous 40-byte area in memory. Successive lines are usually separated by 1024 bytes; every eighth line (lines 8, 16, and so on) has an address 7040 bytes less than the start of the previous line.*

to the next seven-dot group to the right (these are the "shiftout" dots). If you understand this figure and remember that the *bits* corresponding to these dots are stored in reverse within each seven-dot group (byte), then you will understand the essence of this algorithm: to move a single-line image to the right, we split each byte and combine the shiftstay bits of one byte with the shiftout bits of the previous byte. Figure 4a shows how simple it is to shift an image three dots to the right. Unfortunately, when we start looking at manipulating the bits themselves (which, within a byte, are reversed from the way they are displayed on the screen), things get more complicated (see figure 4b). Here is one recipe for manually making the shift (notice that we start with the rightmost byte and work our way left):

1. Shift the second source byte left three bits and put the three overflow bits into the *lower half* of the third destination byte. Hold the right four bits (which have been shifted left three bits) somewhere.
2. Shift the first source byte left three bits. The three overflow bits and the four leftover bits from step 1 join like two adjacent pieces of a jigsaw puzzle. "Fit" them together (using a logical OR instruction) and save them in the second destination byte.
3. Place the remaining bits of the first source byte in the first destination byte.

The 6502 microprocessor inside the Apple can shift only one bit at a time. Therefore, we would have to write a loop of assembly-language code every time we wanted to shift *n* bits. Such a routine would be very slow and would be slower as *n* gets larger.

Enter the Preshift Tables

Bit shifts take too long to calculate, so why don't we precalculate everything and do a simple table lookup instead? We'll need two tables: one for the bits that are shifted out of the byte (which I'll call the *shiftout* value) and another for the bits that remain in the byte, but in their new, shifted position (the *shiftstay* value). A byte has 256 possible values, so each table will take up 256 bytes, for a total of 512 bytes for both tables. We will need these tables for shifts of one through six bits; this takes up a total of 3K bytes of table space, and this overhead is constant whether you have one image to move or a hundred.

(For this article, we've added shiftout and shiftstay tables for a shift of zero bits. This adds an extra 0.5K bytes of tables but greatly simplifies the assembly-language routine needed.)

Figure 5 shows how the shiftout and shiftstay values are created for a given byte, and listings 1 and 2 create the required preshift tables. The tables deal with shifting dots *right*, so the bits in a byte are shifted *left* (remember that bits reverse their positions when they become dots on the high-resolution screen—see figure 2).

The middle line shows the same byte, binary value 11101010, as it is shifted two, three, and four dots (bits). The line above it shows the bits that go into the shiftout byte and the line below it, the

(continued)

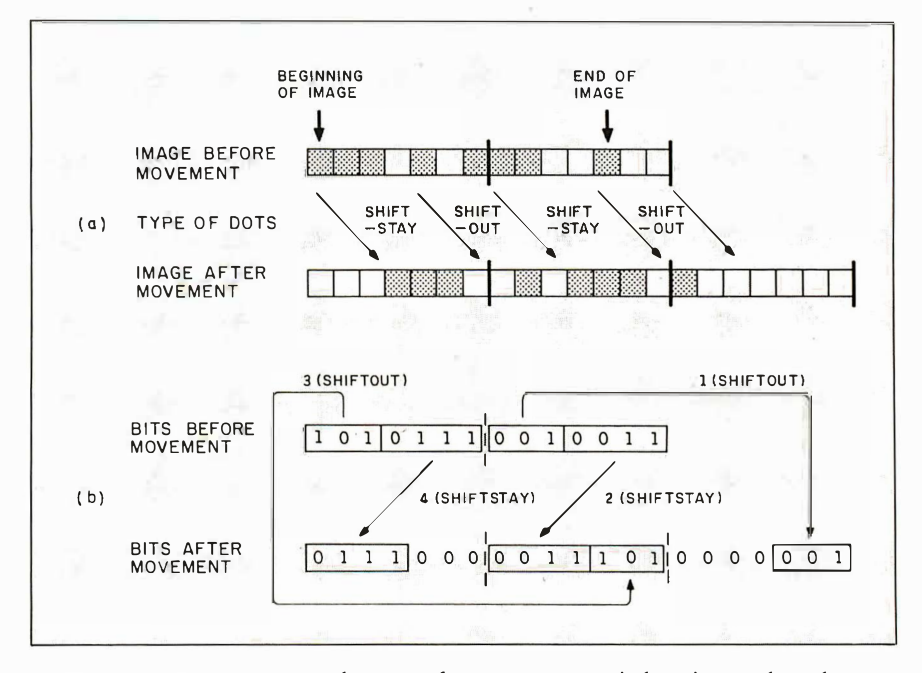


Figure 4: *Moving an image. When a two-byte image is moved three dots to the right (figure 4a), it occupies an extra byte, and the values of the bytes all change in a complex way. Figure 4b shows the bit patterns underlying the original and shifted images (for simplicity, we are ignoring the color bits in each byte). To shift the image right 3 bits, we shift each byte to the left 3 bits and rearrange the pieces in the order shown.*

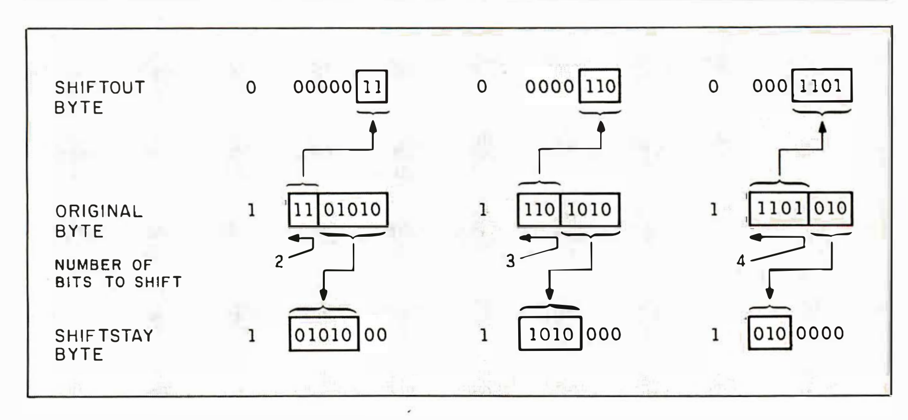


Figure 5: *Creating shiftout bytes (top) and shiftstay bytes (bottom) from an arbitrary byte (center). This figure shows the same byte being shifted two, three, and four bits. Note that the color bit (the leftmost one, outside the boxes) remains with the shiftstay byte.*

shiftstay byte. Notice that the most significant (color) bit, which is not included in the shift, stays with the shiftstay byte. The program in listing 2 makes tables of the shiftout and shiftstay value for each byte (values from 0 to 255) and for each possible value for number of bits shifted (zero to six).

What Are Preshifted Shapes?

The preshifted-shape method is at the root of the most common forms of graphics animation for the Apple II. It is yet another application of the maxim that says, "To make graphics faster, calculate as much as possible in advance, store the results in tables, and do table lookups instead of calculation during the animation process." To shift a shape several dots right or left during the animation (or "on-the-fly," as we call it) would involve lots of byte splitting and recombining and would significantly slow the animation. Instead, we keep seven versions of the shape in memory and select the appropriate one to be "pasted onto" the graphics screen in real time. (We want to deal with whole bytes only, and we need seven versions to take care of all the possible positions of the shape within byte boundaries.)

In addition, by making slight changes to each of the seven shapes, we can achieve "internal animation"—animation of the shape itself as it moves horizontally—at no extra cost. Figure 1 shows a monochrome shape with internal animation in its seven preshifted versions.

Preshifted shapes are the latest word in fast animation. Unfortunately, they take up a lot of room, and it is often inconvenient to maintain a large inventory of such shapes, especially when they are subject to periodic revisions. (Utility packages like Penguin Software's Graphics Magician can help with such tasks.) For example, an image 10 dots square (which is actually 5 dots square in color) must be shifted within an image area 10 lines high by 3 bytes wide (a 10-dot image that begins on the last dot in a byte ends in the second dot of the third byte.) This is 30 bytes per version, or 210 bytes for the entire preshifted shape table—all for an image about the size of a fingernail! In some situations, of course, the method described in this article is a space-saving alternative. —*Gregg Williams*

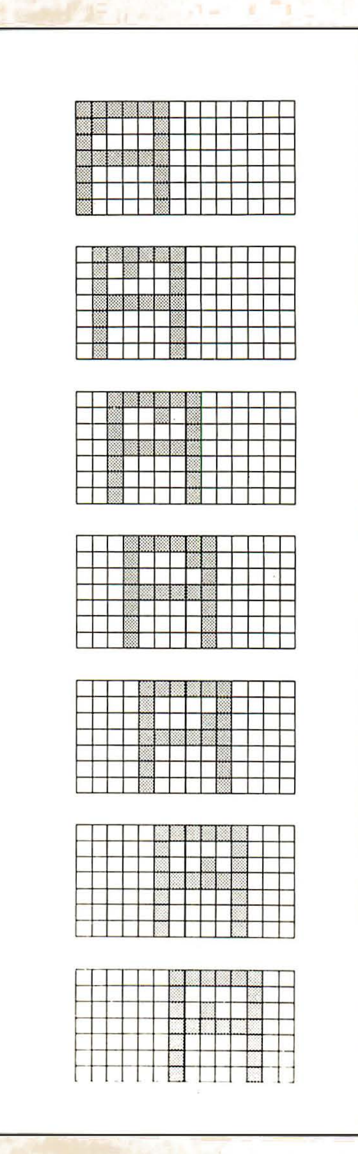


Figure 1: *Apple II preshifted shapes. Depending on the location of the shape within a 2-byte-wide area, a program can "paste" one of the above seven images into that area. In addition, when the seven shapes are drawn into the same area in order, the "A" appears to move to the right, and a little dot rolls around the interior cavity of the "A." This effect is called internal animation.*

The problem of moving a rectangular image is reduced to that of moving a single line of the image, which in turn is reduced to that of moving a single byte of the image between one and six dots (a move of, say, three dots and a move of ten are essentially the same because the extra seven dots—one byte—can be taken care of by adding one to the destination-byte pointer).

Preshifting an Image Line

You may have noticed that the shiftout values are right-justified and the shiftstay values are left-justified within the low 7 bits of the byte. This allows the computer to combine the two image fragments correctly. Figure 6 shows how the core routine (only 23 bytes) accomplishes the task. In particular, figure 6 shows how the shiftstay bits from one byte and the shiftout bits from the byte before it create a new destination byte.

Bill Budge did not get this code density without pulling some tricks. In line 1, the address $*mmmm* is the first byte of the one video line of image that this routine manipulates. The address $*nn*00 is the first byte of the shiftout table being used, and $*pp*00 is the first byte of the shiftstay table. (Remember that the tables must begin on page boundaries—this explains the double zeros in both addresses.) A driver program (discussed below) must change the first address for each new line of image to be processed and must change the last two addresses only at the beginning of a new shift-rectangular-image operation. Yes, this is self-modifying code. It works, and it is necessary to get the speed Budge wanted out of this routine.

The calling program must supply this routine with two other values: the *y* register must contain the width of the image in bytes, and the accumulator (A) must contain zero since there is no previous byte that has left shiftstay bits behind.

Preshifting a Rectangular Image

Given the appropriate shiftout and shiftstay tables (which allow you to split an arbitrary byte by doing two table lookups instead of *n* shift operations), the routine in figure 6 will shift one line of dots and put the result in a buffer area. To make this routine useful, you must surround it with a driver routine that

shifts each line of the rectangular image and does the necessary housekeeping. Many such routines are possible depending on the implementation needed. To illustrate this routine, let's assume that the program has access to an area of memory with image data as specified in table 1. For each line of the image, the driver routine will modify the addresses within the inner loop to point to the right areas, shift a line of the image to the buffer, then transfer the buffer to the correct screen position one byte at a time (see figure 7).

Listing 3 is the final assembly-language subroutine for shifting a block image via the preshift tables and moving it to the screen as described above. The equate statements at the top of the listing show the positions of needed tables and variables. Two tables not yet discussed are the XDIV7 and XMOD7 tables. Because the Apple stores 7 dots per byte, the algorithm needs to divide single-byte numbers by 7 and use either the quotient or remainder. At the expense of 512 bytes (256 bytes per table), we can calculate either quantity as quickly as an indexed load instruction: the *n*th bytes of the XDIV7 and XMOD7 tables are the integer quotient and remainder, respectively, of *n*/7. Listing 4 creates these tables for later use and saves them under the name DIV7 TABLE.

The BASIC program of listing 5 loads the preshift, DIV7, and HIRES1 tables, along with the table for the image to be moved into a single binary file called TABLPAK. The image that the demonstration program is going to move, an arrow pointing diagonally up, takes the form given in table 1 and can be any size. You can change it to any image you wish, as long as the table starts at address 20864 (5180 hexadecimal). When translating a picture of the image to hexadecimal values, remember that the bottom 7 bits of a byte are displayed reversed from the way they are stored; for example, to illuminate the rightmost dot of a seven-dot byte, the byte needed is a 64 (binary 01000000) or a 192 (binary 11000000), not 1 (binary 00000001).

The Demo Program

The BASIC program of listing 6 loads in the TABLPAK package of tables and the

(text continued on page A132)

Listing 1: *The* HIRES1 *program creates the binary file* HIRES1 TABLE. *The first* 192 *bytes of the file contain the low bytes of the starting addresses of line n of high-resolution page* 1; *the second* 192 *bytes of the file contain the high bytes of the same addresses.*

```
]LIST

100 REM
110 REM  HIRES1 PROGRAM
120 REM
130 REM  CREATES TABLE OF ADDRESSES
140 REM  OF FIRST BYTE IN EACH LINE
150 REM  OF HI-RES PAGE 1
160 REM
170 REM  BY GREGG WILLIAMS
180 REM  22 APR 84
190 REM
195 REM  ---------------------------------------------------
197 REM
200 T2BLBGN = 16384
210 REM --BEGINNING OF TABLE AS
220 REM --STORED IN MEMORY
230 REM
235 TBLWDTH = 192
236 REM --WIDTH OF EACH TABLE
237 REM
240 HI1BGN = 8192
250 REM --ADDRESS OF BEGINNING
260 REM --OF HIRES PAGE 1
263 REM
266 ADDR = T2BLBGN
269 REM --THIS PGM CALCULATES
272 REM --ADDRESSES IN ASCENDING
275 REM --ORDER; ADDR HOLDS THE
277 REM --ADDRESS OF THE NEXT
278 REM --TABLE ELEMENT TO BE
279 REM --FILLED
280 REM  ---------------------------------------------------
290 REM
300 REM      MAIN LOOP OF PGM
310 REM
313 HOME : PRINT "CREATING HIRES1 TABLE";
320 FOR I = 0 TO 2
325 : FOR J = 0 TO 7
330 :: FOR K = 0 TO 7
340 :::VL = HI1BGN + 40 * I + 128 * J + 1024 * K
353 :::VHI = INT (VL / 256)
356 :::V2LOW = VL - 256 * VHI
359 ::: POKE ADDR,V2LOW
362 ::: POKE ADDR + TBLWDTH,VHI
366 :::ADDR = ADDR + 1
370 :: NEXT K
375 :: PRINT ".";
380 : NEXT J
384 NEXT I
385 PRINT
386 REM
388 REM --ABOVE ALGORITHM
390 REM --DERIVED FROM TABLES
392 REM --IN APPLE REFERENCE
393 REM --MANUAL
394 REM
400 REM  ---------------------------------------------------
410 REM
420 REM --SAVE FILE TO DISK
430 REM
440 PRINT  CHR$ (4);"BSAVE HIRES1 TABLE,A";T2BLBGN;",L384"
450 REM
455 PRINT : PRINT "TABLE SAVED TO DISK"
460 END
```

(listings continued on page A28)

Listing 2: *The Preshift program creates fourteen 256-byte tables, which are saved as the binary file* PRESHIFT TABLE. *The first seven are the shiftout tables for* 0 *through* 6 *dots, while the last seven are the corresponding shiftstay tables.*

```
]LIST

100 REM
110 REM  CREATE-PRESHIFT-
120 REM  TABLES PROGRAM
125 REM
130 REM  CREATES SHIFTOUT AND
135 REM  SHIFTSTAY TABLES FOR
140 REM  0 THROUGH 6 DOTS
145 REM
150 REM  BY GREGG WILLIAMS,
155 REM  17 APR 84
157 REM
160 REM  --------------------------------------------------
170 REM
180 REM  INITIALIZATION OF
190 REM  CONSTANTS
200 REM
210 BGNTBL = 30720
220 REM --ADDRESS OF START OF
230 REM --TABLE; MUST BE EVENLY
240 REM --DIVISIBLE BY 256
250 REM
260 BININCR = 7 * 256
270 REM --DISTANCE FROM BEGINNING
280 REM --OF SHIFTOUT (SOUT)
283 REM --TO SHIFTSTAY(SSTAY)
286 REM --TABLES
290 REM
300 TBLWDTH = 256
305 REM --DISTANCE BETWEEN
310 REM --ANY TWO TABLES
315 REM
320 C1ZMAXSHF = 6
340 C2MAXBYTEVL = 255
360 REM
380 REM  --------------------------------------------------
400 REM
420 REM  MAIN LOOP
440 REM
450 HOME : PRINT "CREATING PRESHIFT TABLE (THIS WILL TAKE
     SEVERAL MINUTES) ";
460 FOR SHF = 0 TO C1MAXSHF
480 :CURRTBL = BGNTBL + SHF * TBLWDTH
500 : FOR BYTE = 0 TO C2MAXBYTEVL
520 :: GOSUB 1000
540 REM --CALCULATE SHIFTOUT
560 REM --& SHIFTSTAY VALUES
580 REM --FROM SHF AND BYTE
620 REM
640 :: POKE CURRTBL + BYTE,SSTAY
660 :: POKE CURRTBL + BYTE + BIGINCR,SOUT
680 REM --STORE VALUES IN
700 REM --TABLES
720 REM
725 :: PRINT ".";
740 : NEXT BYTE
760 NEXT SHF
770 PRINT
775 REM
780 REM  --------------------------------------------------
800 REM
820 REM  SAVE TABLES AS ONE
840 REM  LARGE DISK FILE
860 REM
880 PRINT  CHR$ (4);"BSAVE PRESHIFT TABLE,A";BGNTBL;",L3584"
890 PRINT : PRINT "TABLE SAVED TO DISK"
900 REM
910 REM  END OF PROGRAM
915 REM
920 END
960 REM  --------------------------------------------------
980 REM
985 REM --SUBROUTINE TO SPLIT
987 REM --AN ARBITRARY 8-BIT
989 REM --VALUE INTO ITS
991 REM --COMPONENTS; SEE
993 REM --TEXT FOR DETAILS
995 REM
1000 IF SHF = 0 THEN SOUT = 0:SSTAY = BYTE: GOTO 1380

1005 REM
1010 REM --THE FOLLOWING CODE IS
1012 REM --DONE IFF SHF>0
1015 C3SCALEOUT = 2 ^ (7 - SHF)
1020 C4SCALNW = 2 ^ SHF
1030 BSVE = BYTE
1040 REM
1060 IF BYTE > = 128 THEN SIGNBIT = 1:BYTE = BYTE - 128: GOTO
     1140
1080 REM  (ELSE IF BYTE< 128)
1100 SIGNBIT = 0
1110 REM  (AND BYTE UNCHANGED
1120 REM
1140 SOUT = INT (BYTE / C3SCALEOUT)
1160 REM --FIND SHIFT-OUT BITS
1180 REM --BY CUTTING OFF RIGHT-
1200 REM --MOST (7-SHF) BITS
1210 REM
1220 SSTAY = 128 * SIGNBIT + (BYTE - SOUT * C3SCALEOUT) *
     C4SCALNW
1240 REM
1260 BYTE = BSVE
1280 REM --RESTORE ORIGINAL
1300 REM --VALUE OF BYTE
1320 REM
1340 REM  END SUBROUTINE
1360 REM
1380 RETURN
```

BYTE NUMBER

ORIGINAL IMAGE (BEING SHIFTED 5 BITS LEFT) — 1 | 01010 01 — (2) — 1 | 11101 11

SHIFTOUT BITS — (3) — 0 | 00 01010

SHIFTSTAY BITS — 1 | 01 00000 — (1) — 1 | 11 00000

RESULT (USING BITWISE 'OR' OPERATION) — 1 | 11 01010 — (4)

```
1  SHIFTIT  LDX  $mmmm,Y      POINTER TO BEGINNING OF IMAGE
2           ORA  $nn00,X      POINTER TO SHIFTOUT TABLE
3           STA  BUFFER+1,Y
4           LDA  $pp00,X      POINTER TO SHIFTSTAY TABLE
5           DEY
6           BPL  SHIFTIT
7           STA  BUFFER
```

(1) SHIFTSTAY BITS FROM PREVIOUS LOOP ARE IN A REGISTER.

(2) [1] X REGISTER IS LOADED WITH CURRENT IMAGE BYTE.

(3) X IS USED AS AN INDEX INTO THE SHIFTOUT TABLE, GIVING THE CORRECT SHIFTOUT VALUE.

(4) [2] THE TWO IMAGE HALVES ARE OR'D INTO THE FINAL DESTINATION IMAGE BYTE.

[3] STORE THE RESULT IN THE BUFFER AREA.

(5) [4] USING X, LOAD A WITH SHIFTSTAY BITS FOR THE NEXT ITERATION OF LOOP.

[5] DECREMENTING THE Y REGISTER SETS IT UP TO ACCESS THE NEXT BYTE IN THE IMAGE DURING THE NEXT LOOP.

[6] IF ENTIRE IMAGE HAS NOT BEEN MOVED (Y>0), GO TO [1]

[7] ELSE STORE FINAL SHIFTSTAY BITS INTO BUFFER.

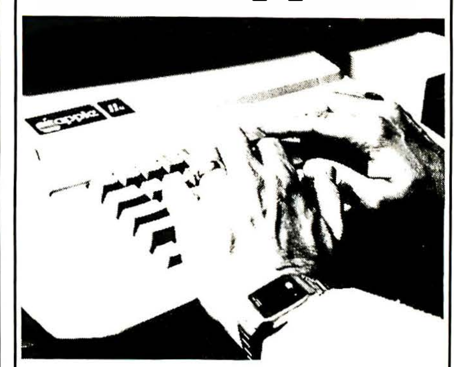
NOTES: 1. IMAGE IS BEING SHIFTED RIGHT FIVE DOTS (BYTES SHIFTED LEFT FIVE BITS).
2. SHIFTSTAY BITS *FROM PREVIOUS BYTE* AND SHIFTOUT BITS *FROM CURRENT BYTE* COMBINE TO MAKE *NEW CURRENT BYTE*.

Figure 6: *The basic preshift-table lookup routine. The top area shows how the code creates a single result byte, the middle area is the actual code, and the bottom area is a commentary. The numbers in the circles and squares relate events to lines of code. Hexadecimal mmmm points to the first byte of the image. The hexadecimal addresses nn00 and pp00 point to the proper shiftout and shiftstay tables, respectively. At the beginning of the routine, the accumulator contains zero and the y register contains the number of bytes in the line.*

(listings continued on page A127)

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BY DANIEL J. GINGRAS

LOW-COST WORD PROCESSING ON THE APPLE

A number of efficient word processors are available for every budget

Cited as the major reason that most people are purchasing microcomputers, word-processing packages have multiplied to the point of confusion in the past several years. Among the recent additions to the word-processing fray are a number of entry-level programs that offer the novice microcomputer user a chance to experience many sophisticated word-processing functions at a price that should not tax even the tightest budget.

When buying a word processor, you should double-check the machine requirements before walking out of the store. Pay specific attention to memory requirements and your Apple's ability to generate lowercase letters. (An entire industry has grown up around supplying lowercase add-on boards to the Apple.) Older Apples can generate lowercase letters with the addition of a Shift-key wire modification. If the word processor you buy does not generate lowercase from software, you will need to add a special piece of hardware to your Apple II+. Both the Apple II+ and the IIe will require an additional board if you want to display text 80 columns across.

Check to see if your printer is supported by the word-processing program before you buy it, particularly if you do not have one of the popular printers. It may be that the word processor you choose will not be able to access all of the features of your printer such as proportional spacing, boldfacing, and underlining.

When shopping for a word processor, devise a sample paragraph that represents the kind of typing you generally do. Take it to the software store and try to enter it, or at least ask the salesman to enter it for you.

The current genre of inexpensive word processors has recognized the inherent difficulty of trying to make the transition from the typewriter to the word processor, and most manufacturers have taken steps to make the programs as easy to use as possible. Remember, however, even learning to use a typewriter requires practice, so you should expect to spend some time with your processor before you become fully productive.

Let's look at several word-processing programs available for the Apple. See table 1 for a comparison of features of the programs reviewed.

THE PERSONAL SECRETARY

The Personal Secretary from Sof/Sys Inc. is a tailored version of the excellent Executive Secretary for the Apple II series (see photo 1). It is an exceptional value in low-cost word processors and is full of features. First, it's not only a word processor but also a small database, which is described by John Riskin, the author of the program, as a "card file" that allows you to create a mailing list that can be merged with your text to create form letters. This is the only word processor of those reviewed to offer such a feature. Not content with simple merging, Personal Secretary also allows specific merging of selected documents, or conditional merging depending on a true/false condition.

One of the most welcome features to be found on any word processor is envelope addressing. This feature allows you to mark the beginning and the end of an address on your letter by typing AD, and when the letter is finished printing, the computer will prompt you to insert an envelope and will print the address. I have not found any other package with such a feature.

Personal Secretary asks several questions about your equipment when you first call it up. Once answered, these questions need never be answered again. In subsequent sessions the program will present a main menu with six entries:

1. Create/Edit Documents
2. Print Documents
3. Edit a Card File
4. Delete/Transfer/Restore

Daniel J. Gingras (31 North Adams St., Manchester, NH 03104), a former magazine and newspaper editor, is currently a publishing consultant. He can be reached through The Source at CPA 062 or CompuServe 72426,254.

5. Set up a document disk
6. Change system features

When you create a document you are prompted "CREATE WHAT DOCUMENT:" and you specify the name. You toggle between the text-entry mode and the editing mode by using the Escape key, and you can scroll the document back and forth using the number keys while in the edit mode. The program allows for scrolling by line, by 10 lines, and by screen and jumps to the beginning or end of the document. The cursor can be moved using the cursor-control keys, or by using the Return key and the slash key on the II+. You can move the cursor on a line a letter at a time or a word at a time, or to the right or left margin immediately.

Personal Secretary lets you create a "shorthand" of printer control codes using "dot" commands. This same feature can be used to create shorthand for frequently used words or phrases. Suppose you have a printer and you want to be able to use its boldface capabilities. Your printer needs to get an Escape 9 to begin boldface. You tell Personal Secretary to define .BF as Escape 9 by typing .BF #27,57, which indicates the ASCII (American Standard Code for Information Interchange) characters for Escape and 9. Now, any time you want to use boldface, simply type .BF. In the same way, you could have defined BYTE magazine as .BT, and every time you typed .BT, BYTE magazine would appear in your text.

You can make a draft print directly from the editor, and the draft printer will ask you if you want the lines numbered or if you want the draft double-spaced. Final copies of a document are "fancy printed" (the final formatted output, as opposed to "draft printed," which prints formatting commands), and you can specify page length, spacing, and other options from the print menu. You can also embed print commands in the document itself, such as indents, right-justified copy, or centered copy.

Documentation for Personal Secretary is excellent, and the manual is organized in the form of a tutorial that takes you through each feature offered by the package. The index is thorough and well organized.

Personal Secretary can also merge other documents such as VisiCalc files into your files, or you can create "boilerplate" text that can be merged with your document by simply typing XT FILENAME.

Sof/Sys also has Executive Speller available separately, which works with Personal Secretary (or any other word processor), and Executive Footnoter, which supports footnotes on complex documents. Executive Footnoter will work with other word processors as well.

Personal Secretary is the best bargain in low-cost word processors. It is more difficult to learn than the easiest of the

(continued)

Table 1: *Comparative features on some low-cost word processors for the Apple.*

Feature	Personal Secretary	The Writer	Bank Street Writer	Home Word	Cut and Paste
Move block	Y	Y	Y	Y	Y
Delete block	Y	Y	Y	Y	Y
Copy block	Y	Y	Y	Y	Y
Search	Y	Y	Y	Y	Y
Search/replace	Y	Y	Y	Y	N
Overstrike/insert	Y	Y	N	Y	N
Multiple inserts	Y	Y	N	Y	Y
Mark envelope address	Y	N	N	N	N
Link another file	N	Y	N	Y	N
Boilerplate text	Y	Y	N	Y	N
Shorthand text	Y	N	N	N	N
Preset tab stops	Y	Y	Y	Y	Y
Draft printing	Y[1]	Y	Y	N	N
Scroll by lines	Y	Y	Y	Y	Y
Scroll by screen	Y	Y	Y	N	Y
Jump to beginning/end	Y	Y	Y	N	Y
Lines shown	24	23	14	14	40
Line width (columns)	40/80	80/128	38	38	21
Merge printing	Y	Y	N	N	N
Internal database	Y	N	N	N	N
Conditional printing	Y	Y	N	N	N
Merge keyboard input	Y	N	N	N	N
Specify line spacing	Y	Y	Y	Y	Y
Justified printing	Y	Y	N	Y	N
Centered printing	Y	Y	Y	Y	Y
Printer control codes	Y	Y	N[3]	N[3]	N[3]
Force new page	Y	Y	N	Y	Y
Specify page numbers	Y	Y	N	Y	N
Page headers	Y	Y	Y	Y	Y
Page footers	N	Y	N	Y	N
Link documents together	Y	Y	N	Y	N
Help screens	Y	Y	N	Y	N
Tutorial	Y[2]	Y	Y[5]	Y[4]	N
Manual pages	48	128	35	35	14
Screen preview	Y	Y	N	Y	N
Auto backup	N	semi	N	Y	N
Change default parameters	Y	Y	Y	Y	Y
Hardware supported:					
Keyboard enhancer	Y	Y	N	N	N
80-column boards	Y	Y	N	N	Y
Shift-key modification	Y	Y	Y	N	N
Memory required	64	48/64	48/64	48	64

Notes: 1) soft preview only; 2) manual; 3) one set-up code only; 4) cassette tape; and 5) on disk.

AT A GLANCE

Name
The Personal Secretary, version 4.1

Manufacturer
Sof/Sys Inc.
4306 Upton Ave. South
Minneapolis, MN 55410
(612) 929-7104

Price
$69.95

Computer Needed
Designed for the Apple IIe, but will work with the Apple II+ with shift-key wire modification; works in 40-column mode with Apple II+ or in 80-column mode with Apple, Full View 80, Smarterm, Superterm, Ultraterm, or Videoterm

Documentation
48-page manual in padded cover

Audience
Any Apple II user who is looking for a low-cost, feature-packed word processor and small database

other packages, but it supports many more features.

THE WRITER

One of the first things that you notice about The Writer is that it is not copy-protected—the only package reviewed for this article that is not. This is an important fact if you plan to use your word processor in a business, since a crash might delay your productivity.

The Writer is easy to use. I selected the 80-column mode and left the Help menu on the screen. This gives you 15 lines of 80-column text to work with. If you turn the Help menu off, you have 23 lines of text on the screen.

The Help menu is exceptional, and multiple Help screens are available simply by typing Control-Q. The cursor-control movements are "full-screen-editing" type, which means you hit Control-E to move up a line and Control-C to move down a line. Many of the control keys are the same as in WordStar. The Writer uses dot commands to control print formatting, some of which are the same as WordStar's.

The documentation is indicative of the complexity and completeness of this program: it's spiral-bound and 127 pages long, and the manufacturer supplies a reference card to jog your memory. The manual is set up in the form of a tutorial. Lessons teach you the basics of the editor first and the text formatter later. The manual is well indexed and very complete.

Editing with The Writer is a joy. Not having to toggle between modes can speed the editing process tremendously, and cursor movements are lightning fast. You can jump the cursor to the top or bottom of the screen using Control-D and then can scroll a screen forward or back using Control-R/Control-V. Cursor movements within the window are made using a diamond of Control E-S-F-C.

As in WordStar, many of the control keys are not mnemonic, and alternate key caps or stickers for the keys would be helpful. Although The Writer does appear to act like WordStar in many respects, the documents that are created by The Writer are not compatible with WordStar.

Scrolling with The Writer is particularly fast, and you can jump from the beginning to the end of a line and back again using Control-B or to the top of the document using Control-T. The status of the editor and the line you are currently typing appear below the editing window. The Help screen, if selected, appears above.

Once you begin a document, it remains in memory until you clear it. You can return to the Command menu by typing Control-Shift-P and there will find a number of options (see photo 2).

The commands are self-explanatory, and with The Writer you can save files in text or binary format. You can also edit both types of files; binary files take less space on the disk and load and save faster than text files, but text files allow you to use other programs such as spelling checkers and communications programs with the document you have created. The Writer is one of the few programs to give you both options.

Typing FILENAME allows you to append another file to your text. The Writer also lets you back up your current document by using a two-letter command—a nice touch if you are working on a complex document that should be saved back to the disk frequently. Typing %W gives you the word count in the document, which is important if you write newspaper or magazine articles and need to keep the text to a

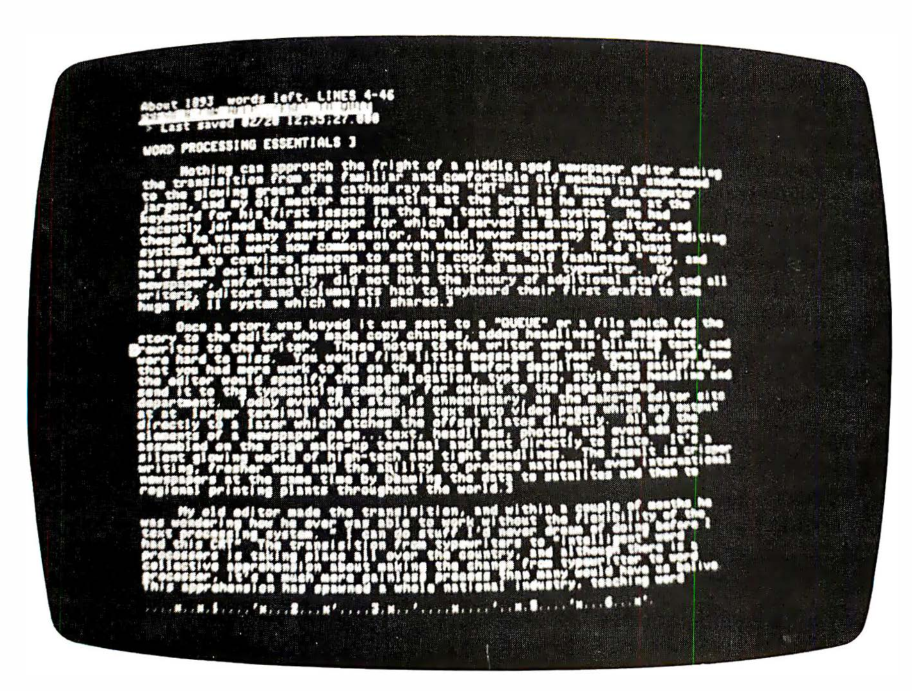


Photo 1: *Personal Secretary used with an 80-column text board on the Apple II+.*

certain word length. You can also embed special printer control codes within the text either by using the "dot" commands that have been previously defined or by actually embedding control codes (or escape sequences) within the text using Control-Shift-M followed by the code. You can also insert unpaddable (mandatory) spaces in the text, such as between words that you do not want split on different lines.

A great strength of The Writer is the flexibility its dot commands add to its output formatter. Some of these controls include:

.PP	Begin paragraph
.NP	Begin NO fill Paragraph
.FI	Fill (Justify)
.SP N	Space down N lines
.BP	Begin page
.in N	Indent N
.he	Header text
.fo	Footer text
*	Comment line, do not print
.ce	Center
.bf	Boldface
.ul	Underline
.NX	Chain to another file

These and other format controls let you merge material from a data file and print form letters, and output your text exactly the way you want. You can also preview the output to the screen before you send it to the printer.

I can recommend The Writer. If you are looking for a low-cost yet full-featured word processor, then this is one of the two packages that you should examine.

Bank Street Writer

Bank Street Writer (see photo 3) is a good word processor, but it has limited uses. It's ideal for those of you who are still afraid of being lost in the computer revolution. Although it contains most of the major features of a standard word processor, it is limited by its small display—only 38 characters across—too small for business correspondence. Broderbund has recognized this problem and has recently announced a new version of Bank Street Writer for the Apple IIc that will display either 40 or 80 columns. This version will also work on the Apple IIe with an extended 80-column card.

Broderbund advertises Bank Street Writer as "the first truly home-oriented word-processing system." Although I'm not sure what the difference is between a "home-oriented" word processor and any other, it would be difficult to beat Bank Street Writer in terms of its ease of use. The disk comes with a tutorial on the reverse side, which takes you through the steps to enter text, move the cursor, correct initial mistakes, erase letters, erase blocks of text (and reinstate them), move blocks of text, etc. The tutorial is so clear even an 8-year-old could begin entering text and correcting elementary errors.

At the top of Bank Street Writer's screen is the menu area. Tapping the Escape key puts you in the Editing menu and allows the cursor to move within the text file. You toggle between the text-entry mode and the menu by using the Escape key. You move the cursor with the I-M-J-K keys, and the cursor movements are displayed as an icon at the top of the screen to remind you.

Once in the Editing menu, you have the choice to perform additional functions such as ERASE, which allows you to specify a segment of your document that is to be eliminated. The program prompts you to move the cursor to the beginning of the block to be erased.

(continued)

AT A GLANCE

Name
The Writer, Apple IIe version
(II+ version available)

Manufacturer
Hayden Software
600 Suffolk St.
Lowell, MA
(800) 343-1218

Price
$49.95

Computer Needed
Apple II+ or IIe, with 48K or 64K bytes; the 64K models will allow both editor and formatter to be loaded at the same time; optional 80-column boards supported; shift-key wire modification or keyboard enhancer required

Documentation
128-page spiral-bound manual, reference cards

Audience
Anyone looking for a full-featured word processor at a low price

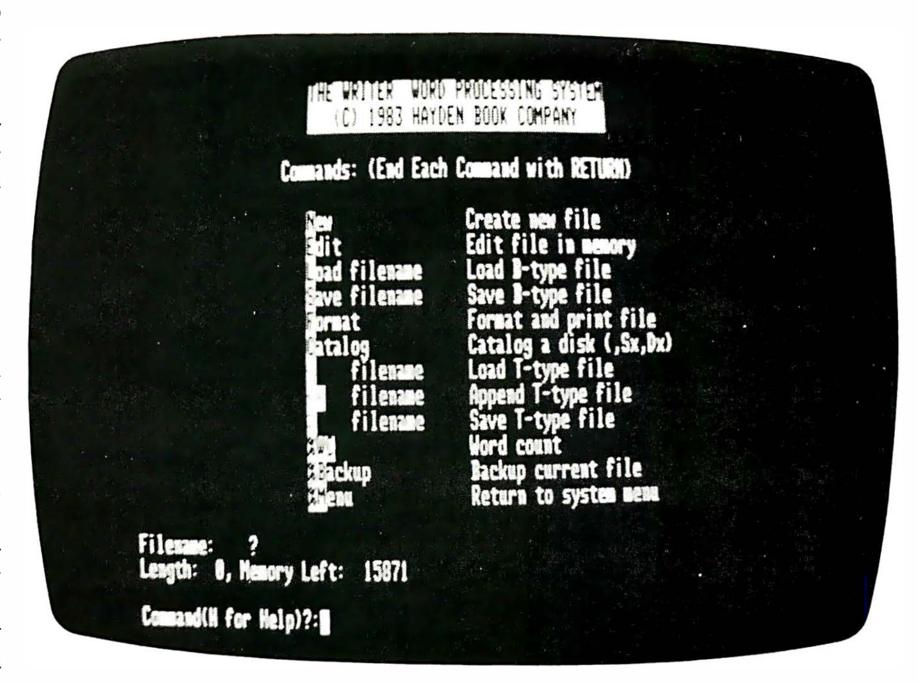


Photo 2: *The command menu for The Writer, the only program reviewed that allows you to make backup copies.*

AT A GLANCE

Name
Bank Street Writer, Apple II version

Manufacturer
Broderbund Software
17 Paul Dr.
San Rafael, CA 94903
(415) 479-1170

Price
$69.95

Computer Needed
Apple II+ with 48K bytes of RAM (version available for IIc and IIe requires 128K bytes and the Extended 80-Column Card on IIe)

Documentation
35-page manual, indexed

Audience
New word-processing users, children, anyone who wants a simple and limited word processor

You then hit Return, and the prompt area at the top of the text screen will ask you to move the cursor to the end of the block to be erased. Hitting the Return key again will cause the area selected to be displayed in inverse video (black on white), and the prompt area will ask you to confirm that the area highlighted is the area to be deleted. If you have made a mistake, there is no problem because Bank Street Writer features an UNERASE command that allows you to replace the text.

The Move function works much the same way, using the same prompts to select an area to be moved and an additional instruction to place the cursor where you want to "paste" the moved copy. Like the ERASE command, the MOVE command also has an UNMOVE option.

The last menu entry is the Transfer menu, which moves you to a submenu that enables you to file, retrieve, and print documents. The Transfer menu allows you to initialize a disk, save a document with a filename of as many as eight characters, and specify a password on the file.

The Transfer menu also lets you retrieve a document from the disk and, if you've forgotten the name of your document, will ask if you need a catalog. You can also save the document from this menu, but saving the document does not erase the current draft from memory, so a Clear function allows you to wipe the memory clean and begin a new document.

Two print options are found on the Transfer menu: Print-Draft and Print-Final. Print-Draft prints the document exactly the way it appears on the screen, limited to 38 characters. It does ask if you want to pause between pages and allows you to add a page heading, but that's about all. Print-Final, on the other hand, will ask you how many characters you want per line (between 40 and 126) and what the space between lines should be. It also asks if this is a continuation of a previous file (in case you want to join documents), and, if so, if the pages are to be numbered. You can print the entire file or just a portion of it. A nifty option of Print-Final will show the top and bottom of a page and allow you to adjust where the page will break, a nice touch that lets you keep paragraph headings and their associated paragraphs together.

A utility program, accessed by pressing Escape twice while the program is loading, allows you to customize Bank Street Writer. Oddly enough, the utility menu lists the filenames on the data disk with their passwords, which makes Bank Street's protection scheme somewhat less than secure. The utility specifies your drive slots and provides a key-clock toggle, a cursor-type (block or underline) toggle, a toggle to allow for a shift-wire modification on the Apple II+ or a keyboard enhancer, and a format converter. The format converter transforms the binary files created by Bank Street Writer to standard text files, and vice versa.

A format converter is essential since Bank Street cannot read standard text files. Also, Bank Street files are binary and on a special disk format that is unreadable by most other programs. Converting files and formats is essential if you want to transfer your files to another word processor or use a data communications program. Unfortunately, the format converter is very slow. It took 8 minutes and 15 seconds to convert a 1500-word draft.

Bank Street Writer is a good program for people who, traditionally, have not



Photo 3: *Bank Street Writer can be used with a spelling checker.*

used their Apples as word processors, particularly owners of older II+ computers who have not modified their machine to display lowercase letters.

The single greatest flaw is the 38-character by 18-line typing screen, which is simply too small to display any but the simplest documents.

HOMEWORD

Homeword is a good choice if you are looking for a simple yet friendly word processor for light work. Sierra On-Line designed its word processor using an Icon menu. When you want to change functions, you toggle from the text-entry mode to the editing mode by hitting the Escape key. A series of icons will appear on the bottom of the screen. Moving the icon frame, you select the function you want. The first array of icons shows a printer, a document with an X through part of it to indicate editing functions, a file cabinet, two documents indicating format options, a pointer indicating customize options, and a floppy disk indicating disk utilities.

When you are in the edit mode, the screen is divided into two windows, a top section for text entry (40 columns by 14 lines) and another window below showing the page you are typing on and two bar graphs indicating free memory and free disk. (A really nice touch in the lower-right corner is a graphic representation of what the full page will look like.)

With Homeword you can customize your documents from the Icon menu (see photo 4). By hitting the Escape key in the editing mode, you are brought to the file icon; by hitting Return, you will bring up the save document mode with the current document title selected. This is particularly helpful if you like to continuously save your document on the disk to ensure against losing it because of a power problem.

Editing with Homeword is quite slow. On the Apple II+ the lack of a Delete key makes correcting the last misstruck character somewhat difficult; the arrow key simply moves the cursor, instead of erasing the last entry.

With Homeword you can erase text by painting areas in inverse video. Homeword also allows you to recover the last erased text. You can move text, copy text, and find and replace words. All the functions are intuitive and surprisingly easy to use.

The print menu offers either continuous or single-sheet paper. From the menu you can indicate the starting page number and preview the document on the screen prior to printing it. You select your printer card from the Customize menu.

The Layout menu enables you to set line spacing, force the start of a new page, and select flush left, flush right, centered, or aligned (justified right/left), print style (bold, normal, or underlined), headings and footings, and indented points.

The Customize menu enables you to select several important options not available on other low-price word processors. You can automatically create a backup of your document. The program can save the last version of your document as a new copy, and the previous version becomes the backup. This feature, standard on many expensive programs, is rare at this price. You can also preset the margins from this menu and specify what type of printer card you are using. You specify the indent points here, as well as the number of disk drives in the system.

Homeword is a very good program for the casual word-processing user. It's

(continued)

AT A GLANCE

Name
Homeword, version for the Apple II+

Manufacturer
Sierra On-Line
Sierra On-Line Building
Coarsegold, CA 93614
(209) 683-6858

Price
$49.95

Computer Needed
Apple II+, IIe

Documentation
35-page manual, tutorial cassette tape designed to teach basics of program features

Audience
Anyone who is looking for an easy-to-learn word processor



Photo 4: *Homeword is limited but has some interesting features, such as the icon menu above.*

AT A GLANCE

Name
Cut and Paste, version Apple IIe

Manufacturer
Electronics Arts
2755 Campus Dr.
San Mateo, CA 94403
(415) 571-7171

Price
$49.95

Computer Needed
Apple IIe

Documentation
14-page manual, reference card

Audience
Students, children, or anyone looking for a simple-to-use but limited word processor

simply too slow for the serious user, and the screen display too limited. It does have, however, good documentation, including on-screen help, a cassette-tape presentation to take you through the basics, and a manual to explain the options.

Sierra On-Line should provide a reference card for the control keys. Most are not mnemonic (Control-O for page up, for example). The manual does have an index, but none of the control functions are included in the manual, and you have to stumble on them almost by accident. If you are having problems that simply can't be solved by looking at the manual, you can call a California number listed here to get help.

Homeword is supplied on a copy-protected disk. Sierra On-Line will sell you a backup for $10 more, a profitable, but unfortunate, practice that prohibits me making an unqualified recommendation.

CUT AND PASTE

Cut and Paste (see photo 5) is a very simple word processor with some unfortunate limitations. You know that Cut and Paste is simple when you look at the documentation, a scant 14 pages, most of which is white space. The Cut and Paste packaging is impressive, with vivid four-color photographs of the programmers seated at a Linotype machine—the implication being that this program will have the impact on history that Ottmar Mergenthaler's typesetting machine did. Hardly.

Cut and Paste is really simple to use. Boot the program, and you are presented with a blank screen. You toggle between the text-entry mode and the Command menu using the Escape key. The Command menu is presented as an inverse block of text at the bottom of the screen, and you select commands by moving a noninverse block to "unhighlight" the command you want. The initial menu presents you with a number of choices including Save, Print, Cut, Paste, Catalog, and Buffer.

To create a document, you select the Catalog command, and then by loading a blank screen, you can enter your copy. Should you want to correct an entry as you type, simply hit the Delete key on the Apple IIe to backspace and erase the last entry. Cut and Paste is always in the insert mode, but should you want to change some text, you will first have to erase the old text, then insert new text. Most serious word-processing users would prefer to have an overstrike mode.

You can also delete a block of copy

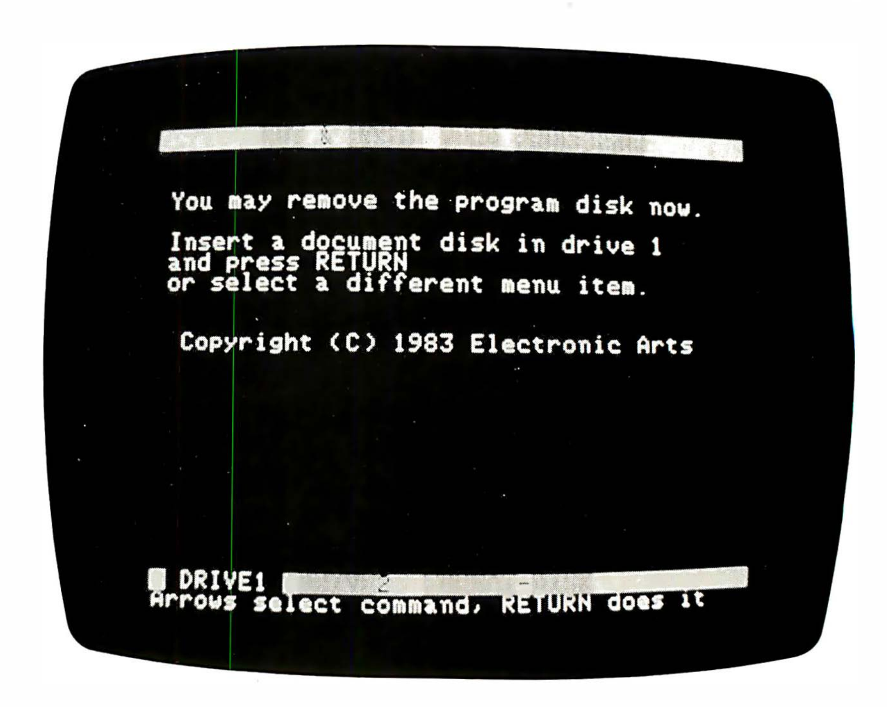


Photo 5: *Cut and Paste is an easy introductory program for young people.*

by choosing Cut on the menu, then marking the text with the left or right arrow key. You cannot move down the text using the down or up arrows, which makes marking a block of copy for deletion a slow process.

You don't have to use the Escape key to toggle the menu. You can select the major commands by typing Control with the appropriate key. The control commands are:

Control-N	Indents five spaces to the right
Control-R	Indents five spaces to the left
Control-A	Followed by arrow keys selects text to be moved or cut
Control-C	Cuts the text into the buffer
Control-P	Pastes down the marked copy
Control-S	Moves cursor to the beginning of the document
Control-E	Moves cursor to the end of document
Control-F	Pages forward
Control-B	Pages back

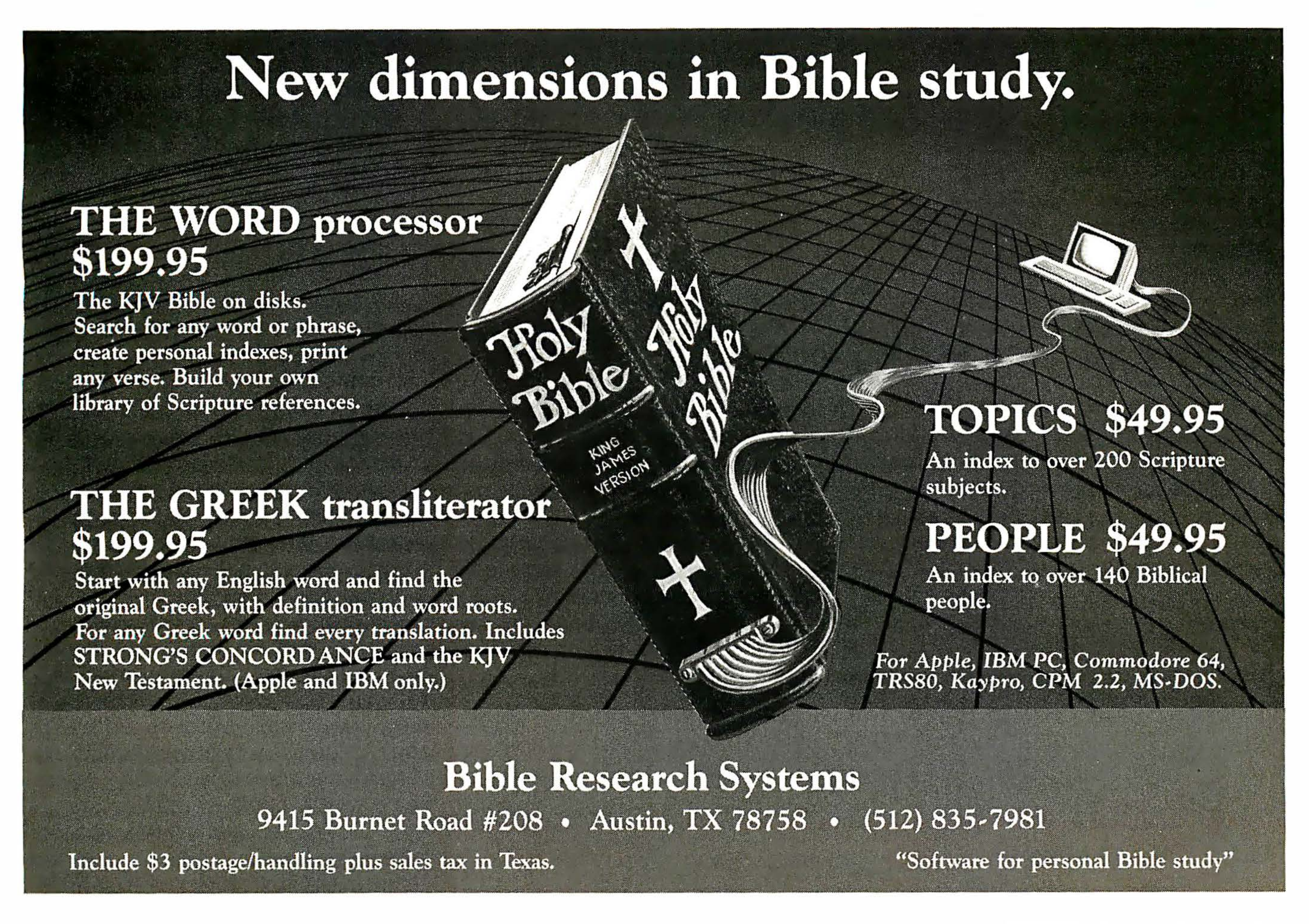
As you become more familiar with the program, you can select these commands directly from the keyboard for faster operation.

The Catalog Menu also allows you to print; delete a document; catalog the disk; copy a disk, which will back up your disk; format a disk, which allows you to create a new data disk; indicate a second drive; and set up a display, allowing you to select 40 or 80 columns and matching the program to your particular printer.

The setup allows you only to specify the pitch that your printer uses, the number of characters on a line, and whether your printer needs a carriage return with a line feed. You have no way of entering printer control strings to initialize your printer or using any of its special features such as underlining or boldfacing.

Cut and Paste has some interesting features, including the ability of the program to "take care" of "widows" and "orphans," which might make the program seem philanthropic, but what it actually does is make sure that there are no last lines from paragraphs that start a new sheet of paper, or first lines of paragraphs that end sheets of paper. A nice touch. The program also assumes that a single-line paragraph is actually a paragraph heading and will ensure that it is kept with the next paragraph. You can also force the start of a new page by typing—on a new line.

Cut and Paste is simple to use, but unfortunately it's much too limited to be of great value as a serious word processor (see table 1). It would make an excellent choice for your school-aged children who are learning to use a computer. ■



Circle 666 on inquiry card.

ALF'S 8088 COPROCESSOR FOR YOUR APPLE

Adding MS-DOS with this board is easy; dealing with the restrictions is the hard part

BY DAVID MORGANSTEIN

Does ALF's new 8088 coprocessor turn your Apple 6502 into an IBM PC? Not quite. Along with some interesting features come a number of drawbacks.

The Alf offerings come as various options. First, you can obtain support software to use the board under Apple DOS 3.3 or Apple Pascal. Second, you can purchase either the MS-DOS operating system or the CP/M-86 operating system, both of which run on the IBM PC. Third, you can buy the add-on memory board with either 64K or 128K bytes of memory. You can use this board as a RAMdisk under DOS 3.3 or as added memory under MS-DOS or CP/M-86. Finally, you can add an 8087 numeric processor to the RAM (random-access read/write memory) board for further speed improvements when performing number-crunching operations. Let's begin by looking at the hardware.

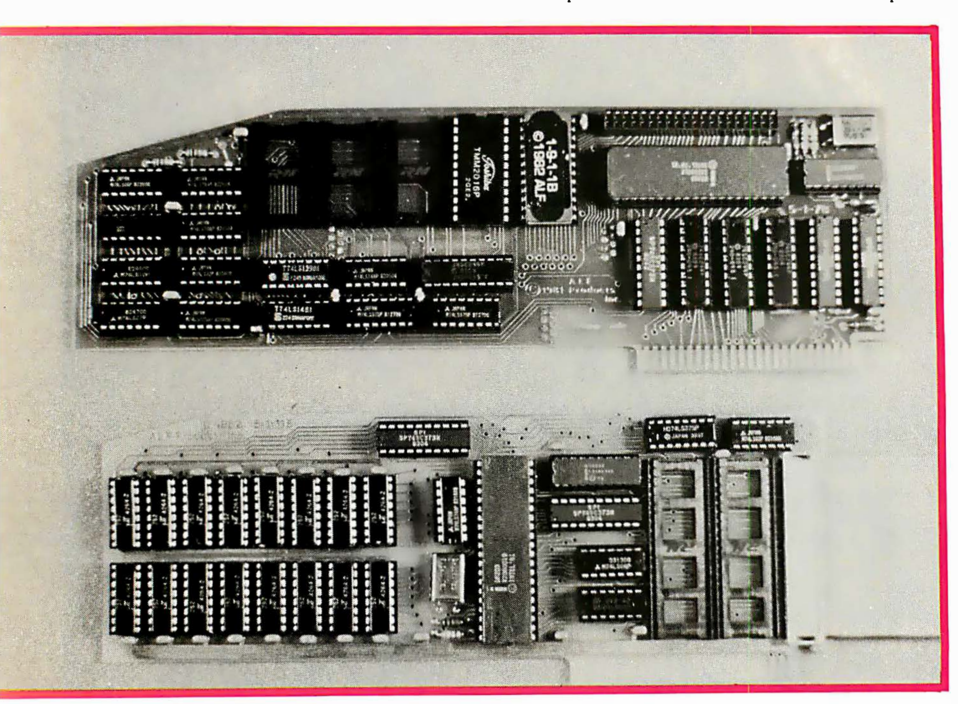


Photo 1: *The Alf coprocessor.*

Both boards are well laid out and of quality construction. The AD8088 contains the 8088 chip, up to 4K bytes of PROM (programmable read-only memory), and as much as 8K bytes of RAM. A plug for a ribbon cable could connect two or more of the 8088 cards. The memory card is available with either 64K or 128K bytes of RAM. It can also be equipped with an 8087 numeric data-processor chip for additional speed when running programs that perform extensive computations.

Software support is provided in several ways. DOS 3.3 programmers can choose from several valuable utilities, including the Formula Transfer Link (FTL), the Multiple Event Timer (MET), and RAMdisk emulation (Memdisk). Pascal programmers can install a Pascal Patch, which hooks several of the p-code commands into the 8088 card for faster execution. In addition, a Transcend Unit permits faster execution of

transcendental functions such as sines and exponentials. For those wanting to run IBM PC software, Alf sells the MS-DOS 1.1 operating system and the newer CP/M-86 operating system in an Apple drive-compatible format.

Installation and Use

The AD8088 card installs easily in any slot, 0 through 7. I have used it only in slot 2 because you must initially install it there to emulate the IBM PC. You can then run a utility to change the default slot. Unfortunately for many Apple owners, this might require removing a modem or serial interface card until the software is reconfigured.

Installing the RAM board is more difficult. Unlike other RAM boards, this one must be connected to the 8088 card via a two-inch ribbon cable. A novice can do this, but routing the cable requires care. Even more challenging is removing the 8088 microprocessor from the AD8088 card and installing it in a socket provided on the RAM board. Removing a 40-pin chip can be a hair-raising, pin-bending experience, especially if you do not have a tool designed for this purpose. The Alf documentation suggests you use a screwdriver. The package does not (but should) include a chip puller, which would have simplified the operation and reduced the chances of damaging the pins on the 8088 chip. Fortunately, the optional 8087 processor easily plugs into the RAM board. When using both boards, you should install them within one slot of each other. Again, both operating systems require that the AD8088 be installed in slot 2 initially, although you can relocate it later.

Once installed, the boards are very easy to use. The documentation and software provided take care of just about everything.

DOS 3.3 Support

If you write Applesoft programs that contain a lot of computations, particularly those with transcendental functions, Alf's Formula Transfer Link (FTL) will speed things up. This machine-language routine automatically routes function calls to the Applesoft ROMs through the 8088 (and, optionally, the 8087). Unfortunately, you must convert the FTL routine from DOS 3.2 to DOS 3.3 before you can use it. This is simple to do with the system utility program, Muffin. ProDOS users will find, however, that FTL does not work at all in their operating systems.

FTL is fairly short, requiring only about 1K byte of RAM. Since most Apple owners have 64K bytes of RAM, this requirement is inconsequential.

How well does FTL perform? The Alf advertisement suggests a factor of three or greater increase in speed. I found a factor of two to be a more realistic assessment. The relative speeds with and without FTL are shown in table 1. The greatest improvement was in the computation of a square root. Note that the speed improvements will result only when function calls, such as transcendentals, are made. There is no speed improvement for most BASIC operations. To test this, I tried one of the BYTE speed-comparison programs, the Sieve of Eratosthenes. As expected, the execution time using FTL was no different. If you purchase the optional 8087 chip, Alf provides a slightly modified version of FTL (FTL87), which reportedly does computations even faster.

Another interesting use of the 8088 card is the ability to time events that occur as quickly as several hundred microseconds or as "slowly" as several hundred milliseconds. The on-board clock has a selectable resolution of 50, 100, or 500 microseconds or 1, 5, 10, 50, or 100 milliseconds. The events you time may have a duration of three seconds at the highest resolution of 50 microseconds or slightly under two hours at the slowest clock speed of 100 milliseconds. The Multiple Event Timer (MET) program allows you to time from 457 to 2505 separate events, depending on the amount of RAM on the 8088 card. MET includes a routine, called MET Read, for accessing the timed results and either displaying them on the screen as values, seeing them in a high-resolution plot, or saving them on disk for later processing. While MET is most valuable for those working with laboratory equipment or software optimization, it will not work while FTL is installed unless you have two 8088 cards.

Table 1: *Time (in seconds) for 300 computations.*

	w/o FTL	with FTL
Sine	20	12
Square (^)	26	11
Log	19	13
Square root	26	14

The Alf memory card is supported by software that permits you to add a "fast disk drive" for speedier processing of disk-based files. Alf provides two programs, Memdisk, which sets up the memory card as a RAMdisk, and Memcopy, which allows you to exchange data between a real disk drive and the RAM drive. Unfortunately, you cannot use the memory card as added RAM or as a language card for the Apple's 6502. Only the 8088 processor can access the memory, so you cannot use the memory card to expand a spreadsheet work space.

Alf does not provide software to permit RAMdisk emulation under the UCSD Pascal or CP/M operating systems.

A handy utility included on the Alf DOS 3.2 disk is a program for increasing the load time of files. Fast Load modifies DOS to permit quicker disk-drive access.

Pascal 1.1 Support

For Pascal users, Alf offers two routines that increase computational speed in Apple Pascal.

Pascal Patch modifies Pascal's P-machine so that certain time-consuming p-code operations are passed to the 8088 card for quicker processing. The patch replaces the MPR (multiply real), DVR (divide real), and MOV (block memory move) p-codes with calls to the 8088. After you make the patch, all calls to the affected op codes should be redirected and speeded up. No changes in existing programs are needed.

A special Transcend Unit is available for additional speed improvements. A USES statement is required at the

(continued)

David Morganstein is vice-president of Westat and president of Washington Apple Pi, a 5000-member users group. He can be reached at 13424 Walnutwood Lane, Germantown, MD 20874.

AT A GLANCE

Name
AD8088 processor card and AD 128K-byte memory card

Type
Coprocessor board, memory board, and support software

Manufacturer
Alf Products Inc.
1315F Nelson St.
Denver, CO 80215
(303) 234-0871

Components
Coprocessor board—5-MHz 8088, 4K-byte PROM, 2K-byte RAM; RAM memory board—64 or 128K-byte RAM

Software
For DOS 3.3—Formula Transfer Link, Multiple Event Timer, and RAMdisk Emulator; for Pascal 1.1—Pascal Patch and Transcend Unit, MS-DOS 1.1, CP/M-86

Optional Hardware
5-MHz 8087 math processor

Documentation
26-page manual for AD 8088 board, includes schematic; 18-page manual for 128K-byte memory board, includes schematic; IBM MS-DOS 1.1 manual with 26-page *Clone Software Guide to AD 8088 Applications*; Digital Research CP/M manual with 36-page *Clone Software Guide to AD 8088 Applications*

Price

AD8088 coprocessor board	$345
Memory Card w/o memory	$295
Each 64K bytes of RAM (max. 128K bytes)	$ 75
MS-DOS 1.1	$100
CP/M-86	$100

beginning of the Pascal code to establish a link to this library unit. No program changes should be necessary. You need only replace the Apple-supplied library unit with the Alf unit to gain access to the 8088 card routines.

The IBM Connection

While 6502 support is of interest, the really intriguing feature of the 8088 card is the possibility of running IBM PC software on your Apple. As the old joke goes, I have good news and bad news. The good news is that you can run 8088 code with the Alf card. This means that many programs written for the IBM PC will run on the Apple. Alf supplied me with the PC's two most frequently used operating systems, CP/M-86 and MS-DOS (version 1.1). The bad news is that this software has to be in Apple disk format because Apple drives are not capable of reading disks formatted on PC drives. Although Alf did not provide any commercial applications programs for me to test under either of these systems, I did receive a list of about 70 programs running under CP/M-86 in Apple disk format that are available from another supplier.

CP/M-86 is an upgraded version of Digital Research's widely used CP/M package, which runs on Z80 boards. Most of its features are similar to those found in the 8-bit version. If you purchase this operating system, you will get the extensive Digital Research manual documenting CP/M-86, a brief addenda written by Clone Software describing certain utilities needed to operate the package on the Apple, three IBM PC-compatible disks containing the Digital software, and three Apple-compatible disks to drive the 8088 card and load the system. One of the three disks is a copy of the operating system in 13-sector format, one is a copy in 16-sector format, and the last is a utility disk in 16-sector format. (Note that two of the IBM-compatible disks contain GSX-86, the Digital graphics extension package. This software is not provided in Apple disk format, however, and probably would not work on the Apple anyway because of hardware differences.)

Once you have installed the 8088 board in slot 2 and have inserted the system disk, booting CP/M-86 is simple. When the computer comes up, you will see the standard Digital Research greeting, in 40-column format. To obtain the

Table 2: CP/M-86 *commands.*

Built-in Command	Function
DIR	Displays filenames in disk directory
DIRS	Displays names of SYS files
ERA	Erases a filename from a disk directory
REN	Lets you rename a file
TYPE	Writes the content of a character file to your console output device
USER	Lets you change user number

Transient Utility Command	Function
ASM86	Translates 8086 assembly-language programs into machine-code form
ASSIGN	Directs I/O to peripheral devices
CONFIG	Programs serial-port operation
DDT86	Program debugger
DSKMAINT	Copies, verifies, and formats your disks
ED	Line editor
FUNCTION	Programs the function keys
GENCMD	Produces executable commands files
HELP	Displays information on commands
PIP	Combines and copies files
STAT	Allows you to examine and alter file status
SUBMIT	Executes a command file
TOD	Sets the data and time display

benefits of an 80-column board or the Alf memory card, you must run a utility program called Adapt. This program allows you to establish various system defaults.

Table 2 lists the standard built-in commands and programs. Users of Z80 CP/M will find familiar programs such as ED for line editing, ASM-86 for assembling 8088 and 8086 code, and DDT-86, the dynamic debugger program for examining memory and disk contents. CP/M-86 does contain a few new commands such as HELP, DSKMAINT, and TOD. The HELP command lists the available options. DSKMAINT performs several useful disk-maintenance functions on IBM drives, including copying disks, formatting blank disks, checking drive speed, and verifying programs. Since Apple drives function differently, four utility programs are provided to supply DSKMAINT's useful services. TOD is used to set and read the date and time.

The most important utility is the Adapt program. As I mentioned earlier, it is used to establish important parameters such as the 8088 card slot number, special device drivers, memory availability, and screen and keyboard function definitions. Unfortunately, I have not been able to install the 80-column driver that should support my Videx board.

The people at Clone Software, who wrote the Apple-compatible utilities, also include a valuable pair of programs for transferring text information between CP/M-86 and Apple DOS disks. Another useful pair of programs is the Upload/Download routine for communicating between Apple CP/M-86 and another version running on different hardware. This routine permits you to convert software you have purchased on IBM-formatted disks into Apple format if you can connect the two computers with an RS-232C umbilical.

Among the CP/M-86 programs available in Apple format are dBASE II, MAG/base, Milestone, SuperCalc 2, T/Maker III, a C compiler, CBASIC-86, Pascal/MT+86, and WordStar. The price list indicates that these products are sold at list prices, rather than the discounted prices found in mail-order ads for IBM PC software. Unfortunately, I cannot tell whether all these programs will run in the Apple environment, because memory limitation and keyboard hardware could present insurmountable difficulties.

Table 3: MS-DOS *commands.*

DOS Command	Function
CHKDSK	Checks disk and memory status
COMP	Compares two files
COPY	Copies files to another disk
DATE	Sets system date
DEL or ERASE	Erases a filename from directory
DIR	Displays filenames in disk directory
DISKCOMP	Compares two disks
DISKCOPY	Copies one disk to another
EXE2BIN	Converts .EXE files to .COM files
FORMAT	Formats blank disk, checks for defects
MODE	Sets mode of operations
PAUSE	Suspends operations
REM	Displays remarks from within batch file
RENAME	Lets you rename a file
SYS	Copies operating-system files to another disk
TIME	Lets you enter or change system time
TYPE	Outputs character file to another device
Utility Programs	**Function**
EDLIN	Line editor
LINKER	Combines object modules, searches library for external references, produces listing and relocatable load module
DEBUG	Loads, alters, or displays files, executes object files

MS-DOS

The MS-DOS provided is version 1.1, which lacks the hierarchical directory structure provided by the more recent version 2.0. It includes Edline for editing text files, Link for linking compiled modules, and Debug for examining and changing memory. Table 3 summarizes the MS-DOS commands and available programs. A comparison of tables 2 and 3 suggests that the MS-DOS software takes up more memory but might be more convenient to run because it has many more built-in commands. Utility programs that must be read in from disk perform fewer functions.

As with CP/M-86, the most important utility provided is the Adapt program. The MS-DOS version works like the CP/M version. Again, I was not able to install the 80-column driver for my Videx board.

The MS-DOS utility disk has the same useful routines supplied with the CP/M-86 system, including text transfer and Upload/Download.

No software for writing a program under MS-DOS is included. The standard package does not contain BASIC or even an assembler. You must buy this package if you are going to run any commercial program, but as such, it is of little value. Alf was not able to send me a list of commercial programs available in Apple format that run under MS-DOS. For now, you might be limited to software originally written for an IBM clone that just happens to work under the hardware restrictions you will encounter.

DOCUMENTATION

Each card comes with a manual describing the hardware and software accompanying it. The manuals clearly explain how to install the cards and include pictures of each step. They also include circuit diagrams and card layouts, permitting technically sophisticated users to troubleshoot problems. The manuals, though brief (25 pages for the 8088 card and 17 pages for the memory card), are complete and contain a table of contents and an index.

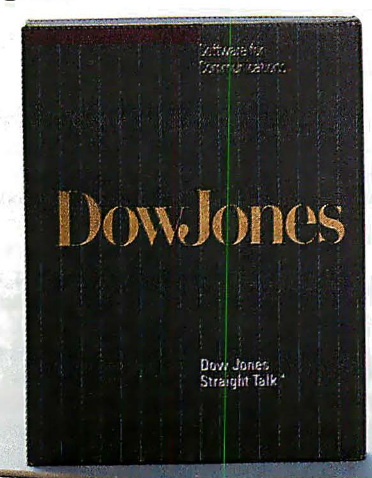
The manual for the 8088 card

(continued)

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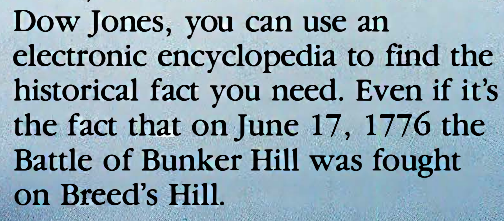
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Unfortunately, no software for writing a program under MS-DOS is included. The standard package does not contain BASIC or even an assembler.

describes the FTL and MET programs for Applesoft programmers. A six-page section for assembly-language programmers discusses the on-board PROM routines.

You can use the routines to generate a random number, multiply or divide, and manipulate 5-byte floating-point numbers. Also included are routines to perform the basic four math functions on floating-point numbers and to compute several transcendentals, such as log and antilog, exponentiation, sine, cosine, and arctangent. The material is clearly presented and very understandable.

The documentation accompanying the CP/M and MS-DOS packages consists of the extensive manuals provided by Digital Research and IBM (written by Microsoft) and a 30-page addenda written by Clone Software regarding its adaptations for the Apple. The Digital and IBM manuals are lengthy, well organized, and thorough. The Clone addenda describe how to boot-up each system on the Apple and how to adapt the systems for various options, such as 80-column displays. The addenda contain some technical material for machine-language programmers who might be interested in developing software for the 8088 chip within each operating system.

Pros and Cons

The Alf 8088 card allows Apple owners to write 8088 or 8086 code using an assembler provided with CP/M-86. Apple-

Circle 674 on inquiry card.

soft or Pascal programmers who require special mathematical functions (such as square root, logarithms, and sines) can increase program execution speed with special routines and patches to the standard operating systems. Those who would like to try programs advertised for the IBM PC might be able to purchase them from a firm that is converting some IBM PC software to Apple-compatible disks.

Potential buyers should be aware of the following limitations, however. In DOS 3.3, the Alf RAM card can be used only as a disk emulator and not as added memory with programs such as spreadsheets. (Expansion of spreadsheet size is a typical rationale for adding a RAM board to an Apple.) Currently, it cannot even be used as a disk emulator within the Pascal or CP/M operating systems. Software developers who want to use the FTL routines in commercial packages will have to obtain a license from Alf.

The biggest problem is that the Apple disk drive is not compatible with the IBM PC disk format. Thus, your Apple drive will not be able to read disks written with an IBM PC or any of its clones. (The reverse is not true, however. There is a card and accompanying support software for the IBM PC that permit the reading of Apple-formatted disks. This incompatibility is due in great part to the fact that Apple drives can write only 35 tracks, while IBM disks have 70 tracks.)

The drive problem is not insurmountable. Rana has announced an 8086 board with disk drives and a controller for the Apple that can emulate the IBM PC. The Rana system reportedly permits you to read Apple- or IBM-formatted disks.

The key to the system is a drive that can read the higher data densities of the IBM PC disk. Thus, if you are going to run IBM software with the Alf card, you will be restricted to packages that have been converted to the Apple format.

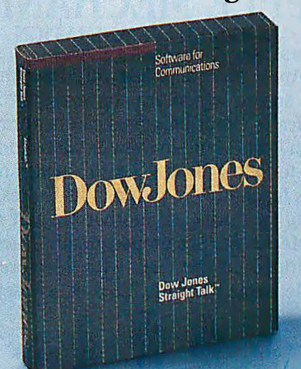
Make sure, however, that any Apple-formatted programs you buy do not call upon special-function keys that are found in IBM hardware but cannot be simulated on the Apple. In addition, be aware of the package's memory requirements. Many IBM PC packages require 256K bytes or more of memory. ■

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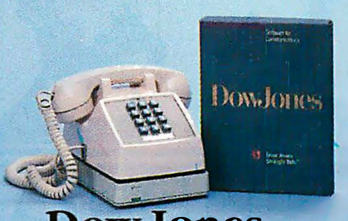
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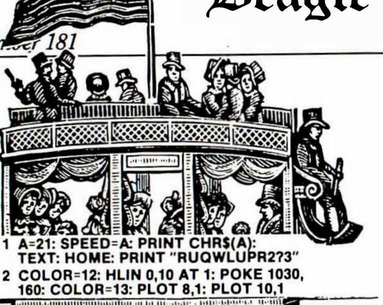
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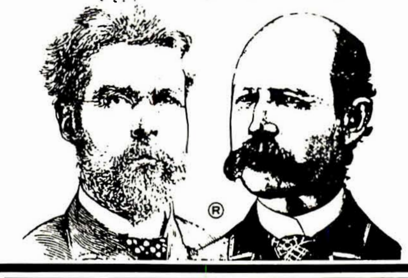
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EXPANDING YOUR APPLE'S APPLICATIONS

Adding CP/M to your Apple II system now means just choosing which board best suits your needs

BY ROBERT A. PECK

Today, not only can you choose from thousands of programs written for the Apple, but, thanks to a number of manufacturers, you can choose from thousands more CP/M programs. The hardware and software packages range from the very simple Z80 add-on board with little documentation to the very complex multifunction board with multiple memory banks and literally pounds of documentation.

Each of them, regardless of complexity, offers access to the wide range of applications currently available under CP/M, giving you many more choices in the ways you can use your Apple.

CP/M

For those of you not familiar with the term, CP/M stands for control program for microcomputers. When you add a CP/M card to your Apple, you are adding the Z80 processor to the system, which is necessary to execute the instructions for CP/M programs. Your Apple essentially becomes a terminal for communicating with the Z80; the 6502 main processor in the Apple becomes a slave to the Z80's requests for input and output.

Manufacturers have used two basic ways to add the Z80 to the system: by sharing the bus and by coprocessor communication.

BUS SHARING

Sharing the bus means that the 6502 and the Z80 processors must take turns using the memory and the I/O (input/output) facilities of the system. Each, in turn, becomes the only master processor of the system at the time it is in control. Each time one processor wants the other to perform some action, it must set up a sequence of instructions for the other processor. It then activates the other processor and immediately "goes to sleep." When the other processor has finished its work, it follows the same kind of actions, dropping off to sleep so that the opposite processor can again take over the system.

Examples of Z80 cards that perform bus sharing are the Microsoft Softcard and the ALS Z-Card II (now known as the Z-engine).

The advantage of bus sharing is that programs for the Z80 can use the Apple memory and peripherals directly, for example, to read the keyboard or joystick, or to write directly to the screen.

The primary disadvantage is that the Z80 must be held to the same speed as the Apple's memory in order to synchronize correctly with it. The standard operating speed of most Z80 systems, such as Osborne, Morrow, and Altos, is 4 MHz. This synchronization forces the Z80 to run at about a 2-MHz effective rate, making the Apple run about half as fast as other systems designed to run CP/M directly.

The speed limitation is not present when you use one of the other CP/M cards surveyed because each of these cards has its own separate memory—no sharing. Each has its own clock, and neither the 6502 in your Apple nor the Z80 on your CP/M card has to shut itself off so that the other can run.

A clever programmer can often take advantage of this by having each processor perform its own separate task. When the processors want to communicate with each other, they do so through a small, fixed set of memory locations, handshaking along the way. (Handshaking refers to message passing in which one processor says, "Here is something for you," and the other says, "Thanks, I've got it.")

Each CP/M board includes a minimum of 64K bytes of high-speed memory, exclusively accessed by the Z80. This memory includes the CP/M operating system and is where CP/M programs reside. The Apple memory for the 6502 processor, as far as CP/M is concerned, contains only the instructions for communicating with the outside world, such as drivers for the 5¼-inch disk units, the 80-column cards, and any other accessory that is to be treated as part of the system.

The boards in the coprocessor category are the Digital Research Gold Card, the Microsoft Premium Softcard IIe, the Advanced Logic System CP/M Card, and

(continued)

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AT A GLANCE

Name
Z-engine (formerly called Z-Card II)

Version of CP/M
2.2

Manufacturer
Advanced Logic Systems
1195 East Arques Ave.
Sunnyvale, CA 94086
(408) 730-0306

Price
$169

Documentation
A 40-page installation booklet, also describing briefly some of the supplied programs

Features
Effective clock rate of approximately 2 MHz; comes with one disk containing a "standard set" of CP/M 2.2 programs (PIP, ASM, LOAD, DUMP, DDT, ED, STAT, SUBMIT, XSUB) and some ALS-supplied utilities; does not include 80-column capability; does not have on-board RAM but uses Apple on-board memory

the Personal Computer Products' Appli-card (Apple II line).

Common Elements

All of these systems have several things in common:

1. The operating system of all of these is Digital Research CP/M, versions 2.2 or 3.0. When you purchase any one of these systems, you become a licensee of Digital Research.
2. All of them have at least 56K bytes of TPA, or transient program area. This is an important point because most standard CP/M programs, such as popular word processors, database managers, and CP/M-based programming languages, can usually run in 56K bytes.
3. All of these cards will work with the standard 35-track Apple disks. This means that if you can purchase or download such programs to Apple-format disks, you will most likely be able to run them under Apple CP/M.
4. Each of the cards can write to a printer interface installed in slot 1. If you have what might be termed a standard Apple system, consisting of the computer, an extended RAM (random-access read/write memory) card (or a IIe), a monitor, two disk units, and a printer, you will be able to run CP/M applications regardless of which card you choose. The only time you may have difficulty is if you have some form of favorite accessory other than what is part of the term "standard Apple system" mentioned above.

Standard Systems vs. Standard Software

Not only is there a distinction between standard and special systems, but there is a distinction between what might be termed standard CP/M and Apple CP/M because of the way the Apple computer is constructed. Sometimes a manufacturer will take advantage of the way in which the Apple is constructed, such as by using the Apple high-resolution graphics mode directly. In this case, a special Apple-only version of a program will be offered. It is designated as an Apple-CP/M program rather than simply a CP/M program.

While I was trying to perform the benchmark testing for this article, an interesting thing happened that truly points out how certain programs, though designated CP/M, are very Apple-specific. For the past few months I have used an Apple that contains a rather odd assortment of cards. In slot 7, there is a StarCard from MicroPro, which I purchased with a WordStar package. (The StarCard is actually an Appli-card from Personal Computer Products.) In slot 4 is a Softcard. Slot 6 has the normal Disk II controller card, and slot 5 has an 8-inch disk controller.

This meant, for example, before I received the 8-inch-controller driver software for the Appli-card, when I wanted a 6-MHz clock speed I would boot the StarCard version of CP/M. When I wanted to put things on the 8-inch disks, I used the 8-inch modification of the Microsoft CP/M. Of course, to transfer data between the two, I used the 5¼-inch disks. Because the Softcard is a bus-sharer and the Appli-card is a coprocessor, neither knew about the other, and neither created any interference in the system. Only the processor whose operating system was loaded talked to the Apple.

During the benchmark testing, I had decided to try to use the GBASIC program on the Microsoft Premium SoftCard IIe disk. All of the testing was to be done on an Apple IIe, and I felt that this would make things more consistent and easier to keep straight.

Since I had had no problems with alternative operating systems in the past, when it came time to benchmark the ALS Z-engine, I neglected to remove the Microsoft Premium Softcard from the auxiliary slot in the Apple IIe. When I booted the ALS version of CP/M, the screen came up normally because the Microsoft card includes the 80-column capability for the IIe. I did not notice any difference at first.

I gave the command to load GBASIC, then to load and run the benchmark program. I was amazed to find that the ALS card, running at effectively 2 MHz, had seemed to have completed the benchmark in *exactly the same time* as the 6-MHz Microsoft Premium Softcard! Well, I was wrong. The GBASIC program supplied with the Premium Softcard is smart enough to load and run with the Softcard instead of the ALS card, even though the ALS CP/M had been booted in the first place.

As a result of this experience, I switched over to the MBASIC program from the Microsoft Softcard disk for the benchmarks. Even this produced some rather unexpected results.

Now let me share some observations about the individual boards.

ALS Z-ENGINE

This is the more recent implementation by Advanced Logic Systems (ALS) of a Z80 card for the Apple. The former version was known as a Z-Card II. According to sources at ALS, this version "should work well both with the Apple IIe and Apple clones due to a change in the way the board synchronizes with the system bus." Other than the slowdown noticed in the benchmark testing (which seems to be about 20 percent), I experienced no difficulties with this card. It is, among those tested, the least expensive way to begin using CP/M.

The ALS Z-engine doesn't have much documentation with it. However, since most users are applications-oriented, only a very small percentage will be inclined to make changes at the system level. Several introductory books on CP/M are available that can help make up for any lack of documentation in this system, since it is "standard CP/M."

SOFTCARD

This board from Microsoft was the first of the CP/M cards available for the Apple II. As such, it has perhaps the largest amount of outside-vendor support. Microsoft provides an introduction to all of the CP/M commands in the manual set, along with a Microsoft BASIC manual. The version of MBASIC and GBASIC included with both of Microsoft's offerings is for "Microsoft (Apple) CP/M."

PREMIUM SOFTCARD IIE

This board from Microsoft includes the Apple IIe 80-column card. The speed of the display update is second only to that of the Gold Card. Additionally, the memory on the Softcard IIe extends the IIe's memory to 128K bytes for those programs that can use it. Likewise, the card supports the new double-density (560 pixels across) color mode.

GOLD CARD

I received the 192K-byte version of the Gold Card for evaluation, along with both sets of boot software (nonbanked 64K-byte and banked 192K-byte CP/M 3.0). Considering the amount of memory, it was surprising that the figures reported by MBASIC showing the percentage of free memory available after the BYTE standard spreadsheet was loaded were so small for the Gold Card as compared to, for example, the ALS CP/M Card (see table 4).

Two other features are worth noting. First, a type-ahead buffer of 256 characters allows you to keep going even when your word processor is doing a disk access (I paid $45 for this feature about two years ago as an add-on board). Second, the resident CCP, or console command processor, is helpful. This is a feature of CP/M 3.0 itself, so it is not unique to the Gold Card. Most applications require that you type Control-C to reset the system (warm start) or to escape to the operating system. In most CP/M 2.2 systems, this means the CCP will be reloaded from the "default disk" (usually drive A). However, if there is a formatted disk in drive A, but no "system" on it, then the system hangs, and you have to do a full Control-Reset to solve the problem. If you change a disk while you are working, the CP/M 2.2 system treats the new disk as read-only until you reset with Control-C.

CP/M 3.0, on the other hand, keeps the CCP resident in memory. The Control-C still resets the system correctly but requires no disk access to get the CCP and, therefore, does not require the system to be resident on the disk in drive A. This was especially handy when, during the benchmark testing, I was loading programs from other CP/M systems from disks whose tracks 0 through 2 did not necessarily contain Gold Card boot information.

The Gold Card's use of memory differs from that of PCPI's Appli-card. Instead of the RAM being specifically defined as a RAMdisk, it is defined under CP/M Plus as a "disk cache." CP/M Plus senses repeated disk accesses no matter which disk they are from. The next time the same sector is requested, it will be read from the cache rather than from the disk.

The disk cache improves the speed of disk operations. However, it does not match the speed of a true RAMdisk.

(continued on page A122)

AT A GLANCE

Name
Softcard

Version of CP/M
2.2

Manufacturer
Microsoft Corporation
Microsoft Building
10700 Northup Way
Bellevue, WA 98004
(206) 828-8080

Price
$345; also available with an 80-column card and a 16K-byte card for an Apple II or II+ as the Softcard Premium Pack for $695

Documentation
A two-volume set, totaling about 370 pages; contains hardware and software details about the system, including the Digital Research CP/M manuals and a manual covering Microsoft BASIC

Features
Effective clock rate of approximately 2 MHz; comes with a "standard set" of CP/M 2.2 utilities, plus MBASIC, GBASIC (MBASIC plus Apple graphics extension), APDOS (to transfer files from Apple DOS to CP/M), CONFIGIO (aids in customizing this CP/M), and DOWNLOAD/UPLOAD (to transfer programs to or from other computers); does not include 80-column capability; does not have on-board RAM but uses Apple on-board memory

THE SEARCH FOR SPEECH

A programmer reviews five speech synthesizers and separates the toys from the tools

BY JOE LAZZARO

I cannot read a normal video screen because of poor vision. I can see my video screen when the other lights in the room are off, but I can't read it. When I got my Apple IIe computer, it was important for me to find a way to use it fully, so I began my search for the perfect speech synthesizer. Such a device should be able to do more than just talk. It should be able to replace the screen.

In this review, I will examine five speech synthesizers—Echo Cricket, Echo II, Intex Talker, Votrax Personal Speech System, and Mockingboard. Table 1 gives a rundown of my assessments.

I have rated these voice synthesizers according to their hardware, software, documentation, speech quality, and flexibility. I ran them on a 128K-byte (though most synthesizers use only 64K bytes) Apple IIe with two disk drives through Apple's Super Serial Card. Three of the synthesizers are self-contained peripherals. Two are Apple-dependent plug-in circuit cards. All of them have different and useful features.

In my evaluation of these five synthesizers, I was looking for a unit that could provide as much information as the screen and speak every keystroke. It should have blind-user commands, high-quality speech, and provisions for a wide range of software.

ECHO CRICKET

Echo Cricket is a 6801 microprocessor-based speech and music synthesizer. The heart of the system is the Texas Instruments TMS5220 speech-processor chip and two General Instruments 8913 sound-effects chips.

I found the voice and music effects of this compact unit very impressive. You can easily create exotic stereo music and sound effects over a range of seven octaves with Cricket's user-friendly sound editor. Cricket is a speech-by-rule system with more than 400 rules and exceptions. ASCII (American Standard Code for Information Interchange) is converted into phonemes under the direction of the rule table. The phonemes are then fed into the 5220 voice chip. This extensive text-to-speech rule table gives Cricket an unlimited male vocabulary.

Cricket also has a female voice with a vocabulary limited to 700 words. The words were selected from lists of the most commonly used English words and computer terms. Unlike the male voice, the female voice sounds almost human. It is a painstakingly encoded set of preselected speech patterns.

Cricket can be driven by either an Apple IIe or Apple IIc computer. You will need an Apple Extended 80-Column Card and the Street Alphabits serial card if you have an Apple IIe. Cricket's text-to-speech and music drivers reside in the 80-column card, leaving 64K bytes of memory free for BASIC programs.

Cricket has no character buffer, so the speech cannot fall behind what is being displayed on the screen. This allows the screen and speech to operate in sync.

Cricket is clean and compact, measuring 10 by 9.5 by 3.5 centimeters. It is the most space-efficient external unit I tested. Cricket comes with a 110-V, 50/60-Hz power supply, full documentation, and a ProDOS-based disk containing music and text-to-speech software. The front panel contains a pilot lamp and volume control, while the back panel (photo 1) has connectors for power and miniplug stereo headphones. Cricket operates at 9600 bps (bits per second). Its data format is preset at 1 start bit, 8 data bits, 1 stop bit, and no parity. I had no trouble interfacing Cricket to my Apple IIe. I only had to install the Alphabits serial card in slot 2 to emulate the Apple IIc.

Cricket makes writing talking-BASIC programs easy. When you use normal Applesoft BASIC PRINT commands, Cricket automatically intercepts everything that goes to the screen and sends it to the 5220.

The SCREENTALK command forces Cricket's software to intercept all characters sent to the screen. This is known as straight text to speech. It is the easiest way to add a voice to your existing BASIC programs. Text to speech will mispronounce a small percentage of English words. (The English language is so full of exceptions that no rule table can cover all the bases.) If you want to avoid mispronunciation, you must construct phonetic strings to send to Cricket. An appendix of phonemes in-

(continued)

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AT A GLANCE

Name
Echo Cricket

Type
Speech and music synthesizer

Manufacturer
Street Electronics Corp.
1140 Mark Ave.
Carpinteria, CA 93103
(805) 684-4593

Price
$179.95

Size
10 by 13 by 3.5 cm

Processor
6801

Features
Unlimited male vocabulary, limited female vocabulary, built-in clock, music and sound effects

Hardware Required
128K-byte Apple with 80-column card and Alphabits serial card or Apple IIc

Software Provided
Disk-based text-to-speech generator with music and sound-effects editors

Documentation
80-page booklet with quick-reference card

Options
Music Construction Set, Peachtree/EduWare educational packages

Voice Chip
Texas Instruments TMS5220

Audience
Users who want a friendly speech system, classroom uses

Comments
Will run on any Apple II or IIc

cluded with Cricket will help you customize Cricket's speech.

Cricket has a single built-in speaker. This provides monophonic voice and music. But you can plug in a Y adapter and separate speakers or stereo headphones.

Cricket has a floppy-disk-based text-to-speech program. Because this software is disk based, Cricket uses about 8K bytes of your computer's on-board memory. Cricket's software adds 45 commands to Applesoft BASIC.

I found Cricket's command structure easy to use. All the commands are in plain English, so they are easy to recognize. They might, however, be time consuming for an advanced user.

Cricket has a built-in clock and alarm. You can use it as an old-fashioned timepiece or to interact with ProDOS. The only other synthesizer to have a clock is Votrax, but you cannot use its clock to time-stamp ProDOS files.

The 80-page Cricket manual is clearly written and well organized. An inexperienced user will find this manual helpful because it painlessly explains how to operate Cricket's extensive musical-effects generators. It has phoneme and musical-note tables for programmers interested in constructing elaborate music and sound effects. The manual includes many examples for inexperienced users but also attends to the needs of advanced programmers.

Because Cricket has a disk-based text-to-speech generator (like Echo II and Mockingboard), making protected software talk is not easy. To add speech to protected software, you will either have to transfer the Cricket text-to-speech program to the protected disk or alter the protected software to revolve around speech output. This will challenge all but the most skilled programmers. Most protected software locks up the host system, so you do not have the opportunity to run Cricket's text-to-speech generators. The problem of getting protected software to talk is not confined to Cricket, however. None of the speech synthesizers on the market have yet reached a level of flexibility

Table 1: *Comparisons of the speech synthesizers tested. Words-per-minute tests were done with a standard 1K-byte text file. Boot times are in seconds, and all values refer to the synthesizer's default (boot) mode.*

	Echo Cricket	Echo II	Intex	Votrax	Mockingboard
Speech quality	good	good	fair	fair	good
Words per minute	80	80	100	76	81
Programmability	no	no	yes	no	no
Buffer size	0	0	2700	3500	0
Music	yes	no	yes	yes	yes
Boot times	15	15	0	0	20
I/O	serial	slot	serial/parallel	serial/parallel	slot



Photo 1: *The Cricket's rear panel has a five-pin DIN I/O cable and room for an external speaker.*

PHOTOS BY PHIL ROUNSEVILLE

that will allow them to make most protected software speak.

All in all, I found Cricket to be of exceptionally high quality. The documentation makes the system easy to learn, and the quality of its stereo music and speech is excellent.

Echo II

The Echo II voice synthesizer card (photo 2) incorporates the Texas Instruments TMS5220NL chip, the same one used in Cricket. The entire board plugs into any Apple expansion slot. I like this plug-in speech card because it allows real-time interaction with the host computer. That means Echo II has no buffer lag time, unlike Intex Talker and Votrax. When a line of text is sent to the screen, Echo II speaks that line before moving to the next one.

I found Echo II very responsive. It is the only synthesizer you can stop instantly in any mode by using the Control-X sequence. Hitting any key restores speech. This is important, especially when you are reading large blocks of text. Echo II and Cricket are the only synthesizers tested to have this useful feature. A talking program can take a lot of time to run, and this feature allows you to skip over menus with which you are familiar.

The Echo II speech-generator disk provides four binary programs for turning text into speech—Textalker, Textalker.RAM, Textalker.Blind, and Speakeasy. They automatically intercept all characters intended for the screen and route them to the 5220 chip. The text is still displayed on the screen in the normal manner, but after a text line appears, it is spoken. Textalker consumes 8K bytes of memory. Textalker.RAM loads its 8K bytes into the RAM card, giving you extra memory for BASIC programs. Textalker.Blind has a screen-review feature for blind programmers, while Speakeasy uses only phonemes and consumes 3K bytes of memory.

When you load any of these speech generators (except Speakeasy), you can continue to write Applesoft programs in the usual way. BASIC will still be BASIC. Making Echo II speak requires no complex routines. Characters enclosed within quotes will be spoken as they are sent to the screen.

In addition to the speech generators, the Textalker disk contains useful, listable BASIC programs and demos that show how to interact with Echo II. There is one drawback to the Textalker speech-generator disk: DOS 3.3 Textalker works only with BASIC or 6502 assembly-language programs. If you want to use C or Pascal, you must purchase a separate language-support disk from Street.

Echo II will occasionally mispronounce certain words. As with the other synthesizers I reviewed, you can use phonemes to customize speech.

The 50-page manual is clearly written and organized. Aimed at the beginner, it also contains phoneme tables and program listings for advanced users. Thanks to the manual, I had Echo II up and talking in less than five minutes.

The drawback of Echo II is that it will not make all programs talk. Any protected software disk that must be cold-booted will not talk because you can-

(continued)

Photo 2: *The Echo II circuit card includes the speech chip from Texas Instruments.*

AT A GLANCE

Name
Echo II

Type
Text-to-speech synthesizer

Manufacturer
Street Electronics Corp.
1140 Mark Ave.
Carpinteria, CA 93103
(805) 684-4593

Price
$129.95

Size
7.5 by 12.5 cm

Processor
Dependent on Apple 6502

Features
Unlimited male vocabulary, optional 700-word female vocabulary, screen-review mode for blind programmers

Hardware Required
Apple II, II+, or IIe with 48K

Software Provided
Textalker text-to-speech utility disk

Documentation
56-page booklet with quick-reference card

Options
Echo Words natural-sounding female voice, C and Pascal support disk

Voice Chip
Texas Instruments TMS5220

Audience
Users who want a friendly speech system, handicapped users

Comments
Turns Apple into a true talking computer

AT A GLANCE

Name
Intex Talker

Type
Text-to-speech synthesizer

Manufacturer
Intex Micro Systems
725 S. Adams Rd., Suite L8
Birmingham, MI 48011
(313) 540-7601

Price
$295

Size
20 by 15.75 by 6 cm

Processor
Internal 6502

Features
Music and sound effects

Hardware Required
Apple II with serial or parallel card

Software Provided
ROM-based text-to-speech firmware

Documentation
33-page manual

Voice Chip
Votrax SC-01

Options
2.7K buffer; user programmable memory; 8-ohm speaker

Audience
Advanced users and programmers

Comments
Will run on any computer with serial or parallel port

not load Textalker into memory.

Another Echo II drawback is its volume control, which is on the card. Every time you want to reset the volume, you have to open your computer. It is possible to reset the volume using Control sequences from the keyboard, but this does not lower the volume as a normal volume control does. Instead, it makes Echo II speak in a lower and lower whisper.

All in all, Echo II is a well constructed hardware/software combination that is easy to use and produces excellent speech. When you plug one into your Apple, it turns your computer into a talking machine, not just a computer that can make limited attempts at speech.

INTEX TALKER

Intex Talker is a 6502 microprocessor-based text-to-speech synthesizer that measures 20 by 15.75 by 6 centimeters. You can interface Intex Talker with any computer that has either a serial or parallel output port (photo 2). The serial input is RS-232C, using a standard DB-25S 25-pin connector. The parallel interface is 8 bits with strobe and acknowledge handshaking, configured with a Centronics-compatible 34-pin edge connector. Intex Talker uses the SC-01 voice-processor chip, the same one used in Votrax. The SC-01 is an older-generation voice processor that has rougher speech than the TI5220 used in the Echo products or the SC-02 used in the Mockingboard. I was not pleased with Intex Talker's speech.

Intex Talker has a 2.7K-byte buffer and 6K bytes of programmable memory. This is useful for the advanced machine-language programmer who wants to add subroutines to the text-to-speech firmware. Intex Talker has a programmable text-to-speech rule-exception table. You can change the pronunciation of any word and store a long list of words on disk. The user-programmable exception table is easy to use.

Intex Talker's data rate adjusts from 75 to 9600 bps (bits per second) and supports XON/XOFF handshaking. The amplifier delivers 1 W (watt) of power into an optional 8-ohm speaker. The standard power supply is hard-wired to the Intex Talker. If anything happens to it, you will have to ship the whole system back for repair.

Intex Talker has a ROM-based text-to-speech algorithm that occupies 6K bytes of memory. I discovered that Intex Talker's firmware makes more pronunciation mistakes than any of the synthesizers tested.

Intex Talker uses none of the host computer's memory. Intex Talker's firmware can make the SC-01 voice chip speak letter by letter, word by word, or line by line. You can adjust Intex Talker's inflection, volume, and speech rate through the firmware. The text-to-speech firmware recognizes any printable ASCII character and performs a synthesis-by-rule analysis, determining which characters are silent or spoken.

When it comes to writing a talking BASIC program, Intex Talker works just like Votrax and Echo II. You can use PRINT commands, declared variables, or data statements.

Intex Talker can echo print every keystroke. You can turn on this feature by sending the string "!DN" (where N is in the range from one to eight). The larger the number N, the longer the delay.

You can adjust Intex Talker's speech rate and pitch through software.

Intex Talker's 33-page manual is oriented toward the advanced user. It contains a lot of technical information but very few examples. It tells you how Intex Talker is constructed but not how to install and operate it easily. The manual would be improved by some extra tutorials and a "getting started" section.

Intex Talker is limited by its older speech processor and its smaller text-to-speech firmware. The firmware lacks fine pronunciation in straight text-to-speech mode. Its straight text-to-speech quality cannot compete with Votrax, Cricket, Echo II, or Mockingboard. To get good speech out of Intex Talker, you must utilize its phonetic programming code fully.

VOTRAX SPEECH SYSTEM

Votrax is a Z80 microprocessor-based text-to-speech synthesizer. You can interface it with almost any computer that has either a serial or parallel output port. Votrax incorporates the SC-01 phoneme synthesizer chip, the same one used in Intex Talker. All text-to-speech operations are performed inside



Photo 3: *The Intex Talker rear panel features a serial and parallel port, as well as an external speaker jack.*

Votrax, using none of the host computer's memory.

Votrax's audio center is composed of the SC-01 speech chip, the musical-tone generator (MTG), the filter-control generator (FCG), and a 1-W amplifier. These four devices are controlled by the execution buffer's firmware. The SC-01 and the MTG generate all voice and music effects. The SC-01 is fed directly into the amplifier. The MTG is switched in or out using software control. The MTG can also be switched to the SC-01 for special voice and sound effects.

Votrax comes with an AC power supply, interface cables, a detailed manual, a quick-reference card of Control commands, and a pocket dictionary of SC-01 phonemes. Votrax has a 3500-character buffer, the largest of all the units tested. Votrax also has a programmable exception table, useful for making up your own pronunciation rules.

Votrax measures 30.5 by 11.5 by 6 centimeters. It is the heaviest and largest of the units tested. The front panel has a volume control and a power-on lamp. The rear panel (photo 4) has serial and parallel interfaces, an AC power jack, an external speaker jack, DIP switches, and a power switch. The whole unit gives me the impression of solidity.

The configuration set-up switches are numbered from 1 to 8. Switches 1 to 3 set the data rate from 75 to 9600 bps. Switch 4 selects between XON/XOFF and RTS (request-to-send) protocols. Switch 5 selects either a 7- or 8-bit word. Switch 6 turns the power-up message on or off. Switch 7 selects between the serial or parallel interface. Switch 8 turns the self-test mode on or off. You can reach these switches easily on the back panel.

Serial handshaking may be either XON/XOFF or RTS protocol. When the input buffer comes within 30 bytes of being full, the XOFF character is transmitted to the host computer. The XON character will be transmitted to the host once the input buffer space returns to 50 bytes. This handshaking prevents the Votrax buffer from overflowing. Intex Talker also has this handshaking capability.

The RTS protocol works just like XON/XOFF. An RS-232C signal from data terminal equipment (DTE) to data communication equipment (DCE) prepares the DCE for data transmission. Instead of sending an XON/XOFF character, the protocol lowers the RTS line (pin 4 on the serial port) to signal that the buffer is almost full. It raises the RTS line when buffer space is available.

The parallel interface has only one mode of handshaking. When the busy line (pin 14 on the parallel port) is high, the host cannot transmit to Votrax. Once this line has been lowered, the host can resume transmission.

The Votrax system's SC-01 voice processor translates standard ASCII text into phonetic code. The software signals

(continued)

AT A GLANCE

Name
Votrax Personal Speech System

Type
Text-to-speech synthesizer

Manufacturer
Votrax Inc.
1358 Rankin
Troy, MI 48083
(800) 521-1350

Price
$400

Size
31.5 by 13.25 by x 8 cm

Processor
Internal Z80

Features
Music and sound effects, programmable clock and alarm

Hardware Required
Serial or parallel card

Software
ROM-based text-to-speech program

Documentation
55-page loose-leaf binder with quick-reference card and phoneme dictionary

Voice Chip
Votrax SC-01

Options
Interface cables

Audience
Programmers who are adding speech to school or industrial computer systems

Comments
Will run on any serial/parallel computer; heavy-duty construction



Photo 4: *The rear panel of the Votrax contains the on/off switch, a parallel and a serial port, DIP switches, and an external speaker jack.*

the speech chip to generate the sound selected by the translator. The voice processor uses built-in pronunciation rules to create words. This allows Votrax to have an unlimited vocabulary. Although Votrax uses the same speech chip as Intex Talker, I found Votrax's speech more pleasing and effective because it has a larger set of phonetic rules in its ROM.

As is the case with any speech synthesizer, Votrax will make occasional pronunciation mistakes. To correct this, you will have to deliberately misspell words, break words into syllables with spaces, or enter words as phonemes. The Votrax phonetic dictionary will help you do this.

Votrax can make nearly any BASIC

Talking Software

We asked Joe Lazzaro and Henry Brugsch, both of whom are blind, to put together this sidebar on programs for the sight impaired. Mr. Lazzaro can be reached at 70 Highland St., Revere, MA 02151. Write to Mr. Brugsch at 32 Morgan Ave., Medford, MA 02155.

Talking software sprang up out of necessity. When computers started flooding the market, blind people were cut off from them. Then a marriage took place. Blind and sighted programmers mated speech synthesizers to their Apple computers. They soon learned, however, that it wasn't enough to make a program talk. They had to develop methods to control the speech, review the screen, and stop the speech. Speech became a tool, not a toy.

Some of these programs were originally written for friends and relatives. Gradually, however, some of the talking-software developers formed companies, and now their products meet the needs of blind computer users throughout the world.

Raised Dot Computing

Raised Dot Computing (408 S. Baldwin St., Madison, WI 53703, (608) 257-9595) is dedicated to producing quality talking software for the blind. The company also publishes a monthly newsletter. Its primary software product is BRAILLE-EDIT, a talking word processor with speech, screen, or Braille input and output. The BRAILLE-EDIT program allows a blind person to do powerful word processing without sighted assistance. BRAILLE-EDIT translates standard text into Braille, large print, or speech. It can also translate text entered with a Braille keyboard into regular text. The program supports the Echo II, Echo GP, Votrax, and Intex Talker speech synthesizers. It also supports the Thiel, Sagem, Resus, Cranmer-modified Perkins Brailler, and Triformations Braille printers.

Raised Dot also has a Braille training program. This is a textbook on disk that teaches Braille to either a sighted or blind person. Its Numbers Program translates the Nemeth Braille code of Mathematics and Scientific Notation into standard print mathematics symbols, while the Electronic Blackboard aids blind teachers. An instructor can enter text in a Braille format and display standard text on an Apple's screen.

The Raised Dot Graphics Package will print any high-resolution file in raised-line Braille on the Cranmer Perkins Brailler. Finally, the company's Lecture Projector neatly formats screens of text or math equations from prestored BRAILLE-EDIT chapters. Raised Dot also offers special cables, Braille manuals, and interfacing guides.

Computer Aids Corporation

Computer Aids (4929 S. Lafayette St., Ft. Wayne, IN 46806, (219) 456-2148) is dedicated to writing useful talking software for the visually impaired. The philosophy of Computer Aids is that software should be easy to use, thus all the company's software is user-friendly.

Documents is a talking, line-oriented, page-oriented word processor. You can move anywhere on the page, tab left or right, tab up or down, center lines, delete words, delete lines, erase entire pages, and merge files. The program costs $195 and supports the Echo II speech synthesizer and all standard printers.

Info is a database manager with up to 30 fields. Versions are available for the Apple II+ and IIe. The program can search multiple records, merge files, sort files by field, and delete records from within files. Info costs $195.

Work Station #1 includes Documents, Info, and Utilities, a program that can copy and initialize disks, copy and delete files, lock and unlock files, and print disk-free space. Work Station #1 costs $375. Work Station #2 includes Documents, Info, the Utilities program, and Agenda, a talking calendar program that allows you to make notes. You can list up to 10 appointments per day and also receive notice of these appointments. You need a clock card to make full use of this program, which costs $95. Directories allows you to create an address file or phone list. You can also make mailing labels and alphabetize the file. It costs $95.

Talking Transcend is a speech-adapted version of the Transcend data-communications package, originally written by Robert Kniskern and Tim Dygert of Transcend Corporation. Talking Transcend allows you to communicate with other computers and timesharing systems and to save files. If you buy the Transpack #2, you get the Hayes Smartmodem and a copy of Talking Transcend for $495. Talk-

program talk. As is the case with the other four synthesizers, you can use BASIC PRINT commands, declared variables, or data statements.

Votrax has a built-in clock and alarm, which you can set and use in applications programs. ASCII character 27 is the Apple's Escape key.

You can also play music and sound effects on Votrax. The effects are comparable to those with Intex Talker, but they are inferior to the stereo Mockingboard and Cricket. Votrax's music and sound effects have a flat, mechanical quality, while Mockingboard's and Cricket's effects have a life all their own.

Votrax cannot echo print, which prevents it from speaking every keystroke. This sometimes results in the system being a line behind what is printed on the screen. Votrax speaks only after a carriage return (ASCII character 13). This is a disadvantage for programmers using Votrax as an output device.

The Votrax documentation is for intermediate to advanced users. Parts of the manual use hexadecimal notation without adequately explaining it. The manual has a lot of examples, detailing use of Votrax's Control sequences.

Votrax is the best-constructed unit I tested. The power supply is heavy duty, as are all I/O (input/output) ports. Votrax is also the most expensive unit I tested. The high price might be warranted if Votrax had an updated speech chip that could produce more pleasing speech and music effects.

MOCKINGBOARD

Mockingboard (photo 5) is a stereo speech and music card made especially for the Apple II. Its music and sound effects are equal to Cricket's, while its straight text-to-speech voice is comparable to Votrax's. This is because Mockingboard incorporates the SSI-263, an upgraded version of the SC-02. It is made of two General Instruments AY-3-8913 sound chips, two 6522 interface adapters, two volume controls, audio cable connectors, two ½-W audio amplifiers, and two Silicon Systems SSI-263 speech chips.

The software is provided on two 5¼-inch floppy disks and is quite extensive. One disk contains text-to-speech programs, text-file readers, text-file writers, and music and sound-effects demonstrations. I was impressed with the stereo music demo. The other disk has an arcade-style game called Battle Cruiser, which takes full advantage of Mockingboard's sound effects. Instead of the bleeps and ticks that most games have, Battle Cruiser contains earth-shattering explosions, blaster rays, and sirens right out of the arcade.

Mockingboard is not a fully interactive speech-output device. Its software does not intercept all characters sent to the screen, and you have to write special routines into BASIC programs to make the board play music, generate sound effects, or speak.

I found the Mockingboard text-to-speech utility more complicated than that of the other units. The others use standard BASIC PRINT commands to initiate speech. For the Mockingboard, you must load several machine-language speech generators, declare strings as MB$, call a subroutine at decimal location 26123, then check the value of a flag at decimal location 255.

Mockingboard does not turn your Apple into a talking computer. Instead, it allows you to write programs that can talk, sing, or explode in stereo.

The Mockingboard manual is a 60-page spiral-bound booklet divided into three basic sections—creation of speech, creation of sound effects, and creation of audio-adapted computer programs. Aimed at the beginner, it has some technical information for intermediate users as well.

Mockingboard has excellent music

(continued)

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ing Transcend alone costs $195.

Braille-out, which costs $95, translates standard Apple text files into grade-two Braille, grade-one Braille, or computer Braille. You can set the line length, page length, indentation for paragraphs, page numbers, and page headers. It also has a user-programmable exception table for the translators. You do not have to know Braille to use this program.

SCIENCE PRODUCTS

Science Products (1043 Lancaster Ave., Berwyn, PA 19312, (215) 296-2111) provides adapted hardware and computer products for the blind. The company sells a complete line of talking test equipment such as voltmeters, calculators, low-vision optical equipment, four-track 15/16 ips (inches per second) cassette recorders, and talking Franklin computers. The company has equipped the Franklin with a voice, using the Echo-II and Echo-GP voice synthesizers. The deluxe model is a double disk drive with volume and pitch controls, a headphone jack, and beepers on the disk drives. The Franklin system also has a special key to tell you when you are in all caps mode.

Science Products also sells accessories such as printers, printer paper, disks, monitors, and talking software. The company carries the full line of Computer Aids Corporation software and serves as a consultant for blind people interested in getting started with computers.

STREET ELECTRONICS

Street Electronics (1140 Mark Ave., Carpinteria, CA 93103, (805) 684-4593) sells a talking terminal program that works with the company's Echo II speech synthesizer. This program turns an Apple into an unintelligent terminal, which cannot capture incoming data. It is useful for using your Apple as a remote terminal for mainframe computer systems.

Street Electronics sells the Echo II with a special version of the Textalker text-to-speech program. This is called Textalker. Blind. Textalker.Blind has a subroutine written into it that allows a blind programmer to reread what is on the screen, either line by line, word by word, or letter by letter.

EXEC SOFTWARE

Exec Software (1201 Waltham St., Lexington, MA 02173, (617) 862-3170) produces the Termexec and Talking Termexec data-communications packages for the Apple II family. Termexec is a complete smart-terminal package that supports the Echo II synthesizer. It allows you to upload and download files, read text files, make error-free copies of programs sent via telephone lines, and use automatic log-on and auto-dial.

Talking Termexec is an upgrade of the original Termexec. Talking Termexec supports a host of special features, including the line-review mode, which allows you to view previously spoken material. The latest features allow immediate on/off switching for speech during any phase of program use. Talking Termexec also supports X-modem protocol, an error-checking system that permits the transfer of data in a variety of formats.

—Joe Lazzaro and Henry Brugsch

AT A GLANCE

Name
Mockingboard

Type
Music and sound-effects synthesizer (optional speech capability)

Manufacturer
Sweet Micro Systems
50 Freeway Dr.
Cranston, RI 02920
(401) 461-0530

Price
$124.95 for music and sound effects;
$195 for music, sound effects, and speech

Size
7 by 17 cm

Processor
Apple 6502 dependent

Features
Stereo music and sound effects, programmable speech-rule table

Hardware Required
48K-byte Apple II, external 8-ohm speakers

Software
Sound and speech-development tools on two floppy disks

Documentation
63-page spiral-bound manual

Voice Chip
Votrax 2C-02 (SSI263)

Options
Voice-upgrade chip ($99)

Audience
Programmers interested in creating stereo sound effects and speech for applications programs

Comments
Excellent music and special effects

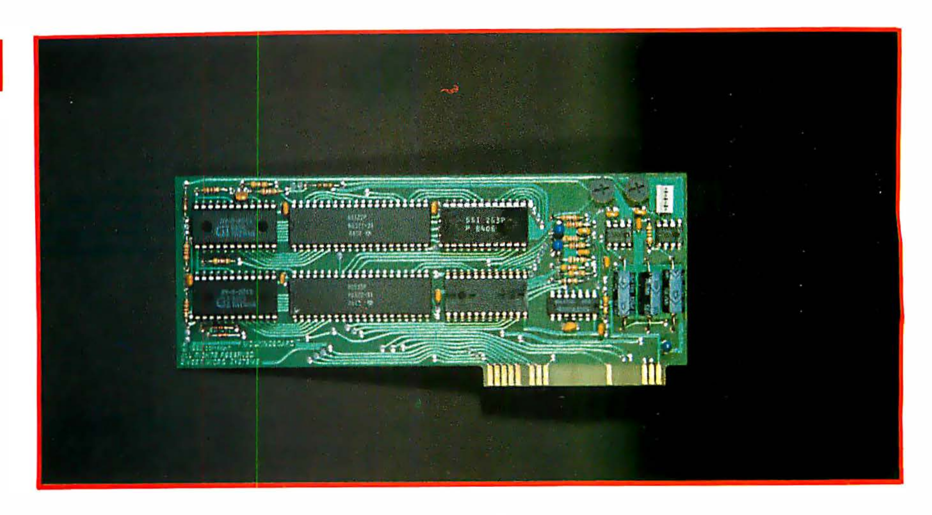


Photo 5: *The Mockingboard has twin music chips and a single speech chip, but there is room for a second speech chip.*

and sound effects. Its straight text-to-speech quality is not quite as good as Cricket's or Echo II's. I like having stereo music and speech capability on a single board. When I plugged Mockingboard into my 80-W stereo receiver, it nearly brought my apartment building down.

Making a BASIC program talk is a little more difficult with Mockingboard than with the other synthesizers, but I think it is worth the extra effort. Though Mockingboard is a highly flexible music and speech synthesizer, it is not suitable for my purposes because of its inability to intercept all characters sent to the screen. If this capability were added, Mockingboard would be very close to my definition of the perfect speech synthesizer.

Conclusion

All five synthesizers ran well on my Apple IIe, but each has its own personality. Cricket is a high-quality, flexible speech and music synthesizer with excellent speech and musical effects. Its disk-based text-to-speech algorithm is very accurate, and the system is easy to use because all speech and music commands mimic BASIC.

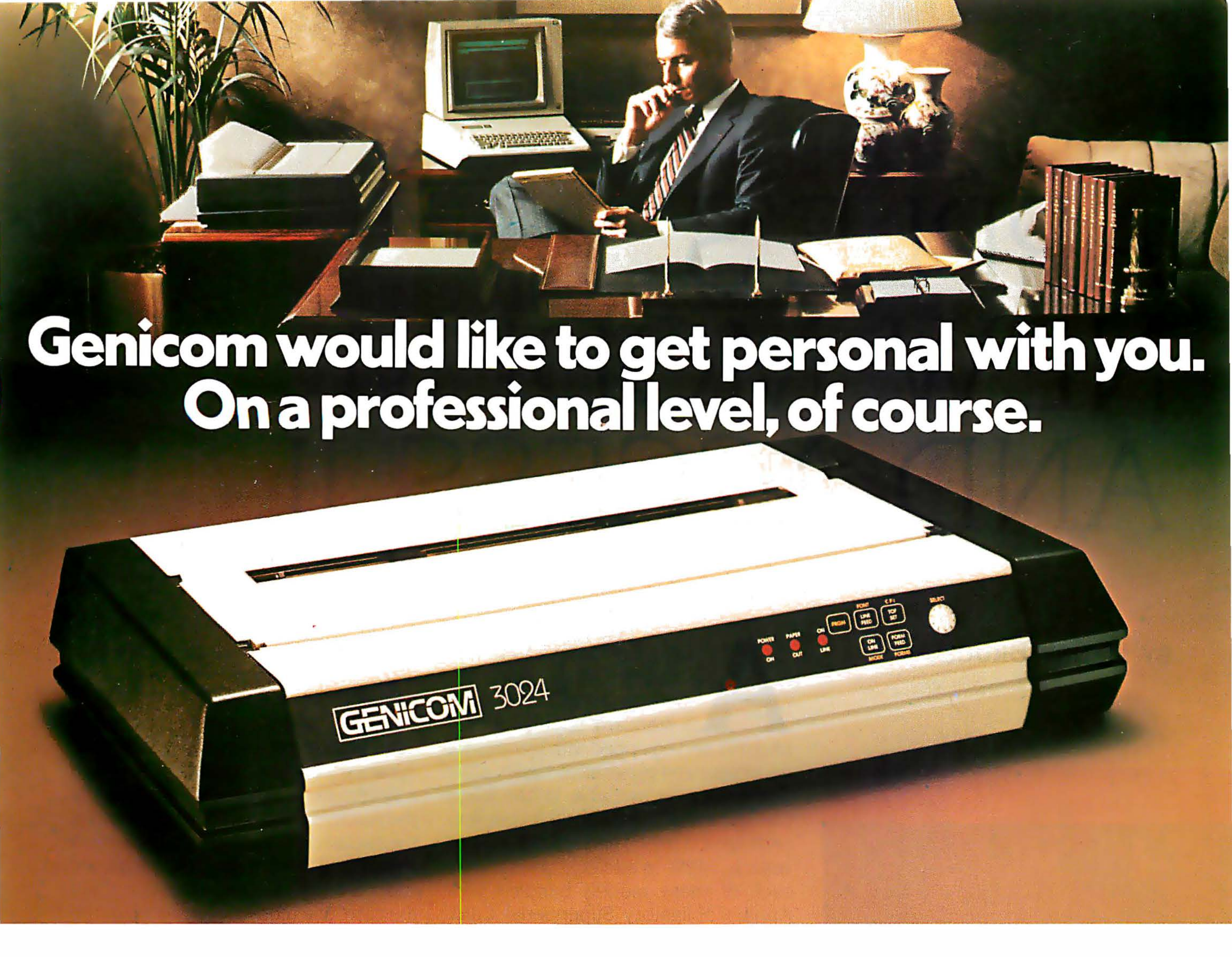
Echo II's greatest advantage is that it was made especially for Apple II vintage computers. It comes closest to my definition of the perfect speech synthesizer because it turns the Apple into a fully functional talking computer. Its only limitation is that its text-to-speech software is disk based. If this software were burned into ROM, Echo II would probably be able to run most protected software. The system has very good speech, is easy to use, and is the least expensive synthesizer reviewed.

Intex Talker has the least-understandable speech of the units tested, but it is the only one that offers detailed hardware descriptions for the advanced hobbyist. It has the advantage of being serial and parallel driven. Intex Talker can echo print, but its voice quality suffers from a small text-to-speech algorithm.

Votrax is a heavily constructed system. Although it uses the same speech processor as Intex Talker, its ROM-based text-to-speech firmware is more comprehensive, making for better pronunciation. It has a useful built-in clock and alarm, but it cannot echo print.

Mockingboard offers high-quality stereo music effects. Its speech falls behind the Echo products but is better than either Intex Talker's or Votrax's. Its software limits its speech output, and no software drivers are available to make it intercept the screen or echo print. Its speech quality is fair.

Speech synthesis has come a long way, and the technology continues to improve. Speech synthesizers still need specialized operating software, however, and my search for perfect speech will not end until personal computers have tailor-made speech synthesizers that allow their software libraries to talk. ■



Personal computers have become a valuable asset in business. The problem is that most personal computer systems are originally sold with "personal printers"...printers built for home use, not for heavier business work.

These "personal printers" are too slow for many business needs. They can tie-up your computer for extended periods of time...time you could be using to do other work.

Another problem is durability. In business, you need a printer that can produce high volume output over a long duty cycle. The common "personal printer" will often just quit under such continuous operation.

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Price/performance matched for small business systems, the Genicom 3000 PC printers are designed to increase productivity and maximize the value of your personal computer.

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Genicom 3000 PC printers feature switch selectable hardware, dual connectors and dual parallel or serial interfaces. Plus the 3014 and 3024 emulate popular protocols for both Epson MX with GRAFTRAX-PLUS™ and Okidata Microline 84 Step 2™; while the 3304 and 3404 emulate popular protocols for Epson MX with GRAFTRAX-PLUS™. So your current system is most likely already capable of working with these Genicom printers without modification.

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Circle 677 on inquiry card.

APPLE'S NEW MODEM AND ACCESS II

BY HENRY BRUGSCH



Photo 1: *An extremely efficient footprint characterizes Apple's modem. It requires no more desk space than a standard telephone set.*

Apple Computer's new modem is cleanly designed, cleverly styled to fit under a standard telephone (see photo 1), and equipped with features for neophytes and experienced users alike. The modem is available in two basic configurations: a 300-bps (bits per second) version ($235) and a 300/1200-bps version ($499). In addition, you can buy each of these models bundled with Apple's obligatory Super-Serial Card. Terminal software and well-written documentation complete the package.

Both modem versions support several data formats, including serial, binary, and asynchronous. Custom data formats are also possible. The modem operates in several modes as well. These include manual originate and answer, automatic originate and answer, auto-dial, communications mode, and full- or half-duplex. Receiver dynamic range is a respectable 45 dB (decibels) in the full-duplex mode, and bit error rates of one in 10^6 bits are specified on voice grade channels. The modem also performs local analog loop-back testing.

I have been using the 300/1200-bps version of this modem for several weeks, and I find it really first-class. The only major criticism I can level at it is the way the power connector is set up. It is a nonstandard variety (see photo 2), configured in a triangle of three pins within a flexible plastic housing. The modem has a keyed slot to receive the female plug, and this is where problems arise. The female end is about a quarter-inch deep, no deeper in fact than the barrel of a typical audio earphone plug. In this constricted space reside three rather minuscule pins. The result is that reliable connections can be problematic unless users take extreme care when plugging in the power jack.

Another power-supply-related problem I encountered was also mechanical in nature. I couldn't use the modem with a system-saver power-line filter. Ideally, the modem should occupy only one of the two sockets supplied on the system saver. Due to the way the plugs are spaced on the system saver, this is not the case. The modem plug occupies the space of two plugs. This means you must reconcile yourself to using one plug of the system saver at a time.

MODEM COMMANDS

The Apple modem is capable of performing sophisticated data-communications operations. The degree of this sophistication is mirrored in the modem's rich command set. Apple modem commands can be divided into three categories: general, special, and dial commands.

General commands allow you to initiate specified modem functions directly from the keyboard. Special commands initiate self-test and repeat functions, as well as escape sequences. Dial commands control Touch-Tone and pulse-dialing operations. A command summary appears in table 1.

The manual recommends minimal use of complex command strings. Users are urged to let the terminal software do the work of setting data rate (the speed at which data is transmitted) and data format (the complex arrangement of data bits).

Most users will never have to deal with many of these commands. The modem's main functions are software-

Apple's latest hardware and software offerings are a smart choice if communications are your interest



Photo 2: *The modem's rear panel serves as the mounting space for incoming and outgoing modular telephone jacks, three* DIP *(dual-inline pin) switches, power plug, on/off switch, and* DB9 *female connector.* DIP *switches control carrier-detect mode, balance capacitor insertion, and respond to data-terminal-ready signal.*

driven and thus don't require human intervention. A number of commands do have interesting effects, however. For example, I have found a feature that is quite useful. The A/ command allows you to retrieve a number you have just dialed. If you receive a busy signal from a host computer, you can hit an "h," which will issue the three plus characters to the modem, and you will be disconnected from the host in a second. Hit the A/ and you will be reinstated using the previously dialed number. Most terminal programs incorporate redial features, but sometimes it may be quicker to hit the A/ and be done.

Another interesting effect is the discontinue feature. According to the manual, three plus signs disconnect the modem from an existing connection. True, but if you are in the process of originating a call, you can escape this situation by pressing any key. This the manual doesn't tell you.

The modem also provides you with a helpful audible clue if you are not sure of what data rate you are using: 1200 or 300 bps. You can adjust the speaker volume with a screw located on the underside of the modem. The speaker can also be toggled on or off.

One slightly annoying feature is that the modem's default state, the condition it is in when switched on, is answer mode. It will answer your phone while powered up until you either shut it off or change the answer mode with the appropriate command.

Appleterm and Access II

The modem is supplied with Appleterm, a bare-bones terminal program that does not allow uploading or downloading of data. Using Appleterm, however, you can browse through information services like The Source, Dow Jones News/Retrieval, and CompuServe. (A special subscription to The Source and a free CompuServe demonstration are included in the price of the modem.) A modem self-test routine is also included in the Appleterm program. If you want more features than these simple functions, you will soon outgrow this program.

The Appleterm program is aimed at novice users. It is designed to let you use the modem without benefit of being able to save or send programs. What this program will do is let your microcomputer act as a terminal using another computer as a host.

The manuals supplied with the Apple modem detail the uses of Appleterm and exhaustively describe its features. The manuals also provide a tutorial that walks the novice through a communication session.

Apple's Access II program ($75) is Apple Computer's attempt at a definitive communications software package. And it is just that. It allows for emulation of non-Apple terminals such as VT52 and 500 DEC terminals and also provides a number of ProDOS utilities. In fact, the program is based on the ProDOS operating system.

The program provides a wide range

(continued)

Henry Brugsch, a graduate of Tufts University, works as a piano tuner in the Boston area. He is involved in developing terminal software for the vision-impaired. He can be reached at 32 Morgan Ave., Medford, MA 02155.

AT A GLANCE

Name
Access II

Language
Pascal

Manufacturer
Apple Computer Inc.
20525 Mariani Ave.
Mail Stop 23AD
Cupertino, CA 95014
(408) 996-1010

Computer Needed
Apple IIe; not II or II+ due to incompatibility of keyboard configuration; minimum one 64K-byte drive

Features
Auto-dial; auto-log on; Xmodem facility; Appleworks compatibility; menu-driven; based on ProDOS

Price
$75

Documentation
Product training disk, manual

Audience
Particularly helpful for modem novices using an Apple Modem 300 or 1200

of facilities and is menu-driven. From the menu, you can configure terminal parameters, such as data rate and data format, and the type of emulation required. You can also select whether you want to send or receive a file and whether or not you would like to enter terminal mode. There are also eight auto-dial numbers, which can be retained in memory. The program also remembers hardware and terminal protocol configurations. You can save a variety of configurations. The option to create macro commands allows you to select from the auto-dial format a specific group of predesignated parameters. These might include the data format and data rate required by the host and your password to a given service.

Also included with the program is a tutorial disk providing a complete demonstration. This demo is so realistic, the experience of signing onto a database, collecting information, and signing off can be had without ever picking up a phone. From this tutorial, the beginner gets the feel of dealing with a remote computer. All of the sights and sounds are there—even modem tones and the sounds of Touch-Tone dialing.

Using Access II

Once you have mastered the tutorial and feel it is time to try some on-line communications, you may wish to tie into your favorite bulletin board or mainframe to download some information. When you boot the disk containing the Access II program, be sure you have a Super-Serial card and a modem connected to slot 2. If you do not have either of these, the disk will hang up.

Assuming that all of your hardware configurations are set and you are in terminal mode, you will see a display that informs you that you are tied into the mainframe you have opted to receive.

If you want to receive a file, it is wise to ensure that all prior conditions have been met. That means that an initialized ProDOS disk is available and that you know its volume and filename. This is crucial because the program must have an open recording file in order to func-

Table 1: A *partial summary of Apple modem commands.*

Command	Action
E0	Echo function turned off.
E1	Echo function turned on.
F0	Full-duplex operation selected.
F1	Half-duplex operation selected.
M1	Monitor speaker turned on during acquisition only.
M0	Monitor speaker turned off.
M2	Monitor speaker turned on for duration of connection.
P (telephone #)	Pulse-dial mode selected; specified number dialed.
S0 = *n*	Answer mode command where *n* is a number from 1 to 30, which is the length in time in seconds the phone is allowed to ring. If S0 = 0 is set, the phone will not be answered.
S2 = *n*	Escape sequence or hang-up command; n = ASCII value of escape character.
S7 = *n*	Connect abort command; n = 1–30 seconds.
T (telephone #)	Touch-Tone dial mode selected; specified number dialed.
V0	Response code displayed.
V01	Response string displayed.
d	Dial command; all subsequent numbers dialed.
A	Answer-mode command; phone answered automatically.
Q0	Modem command display toggled on.
Q1	Modem command display toggled off.
A/	Repeats previous command.
+++	Default escape sequence; hands up phone.

tion properly. When you boot the program, assuming you have changed nothing, you are in a position to record a file called "Termrec." This file is available on the main program disk and is opened upon initialization. Unfortunately, there is not enough space on the Access II disk to accept a full load of data. Time to go into your utilities section of the program and create a new disk for file storage.

After this is done, you can go back to the program and reopen the recording file. You must enter the appropriate section of the menu to do this. You will be prompted by the program to enter the new volume and filename. Now you are ready to go.

This seems like a lot of work, and it is. Once you master the intricacies of ProDOS, though, you have available a fast 1200-bps system. I was able to download large amounts of data, and disk access was quick and efficient. The program holds about 3000 bytes of data in the buffer and then dumps it to disk. No matter how long the disk has been filling, or how much data has been entered, the disk access time is never more than 2 or 3 seconds.

Some Shortcomings

One of Access II's shortcomings is its passive answer mode. The person calling in has no control over the machine, and the program must rely on both parties in a terminal session to manage complicated file handling. For example, if you want to exchange a file under the Xmodem protocol using Access II, both parties must actively work at establishing a communications link. Once communications are established, both parties must go back to their main menus and opt for Xmodem transfer. The one who is receiving *must* set up his software first. The person who is originating the program must leave the terminal mode to send a file. To do so he has to perform a bit of mental telepathy in order to determine when the receiving end is ready to accept the first stream of data. Because of the passive nature of Access II, it is not possible for one computer to gain control over the other—thus, the communication gymnastics.

While using the Access II program, I attempted to download a file that was 150 sectors in length. As accuracy was needed, I used the program's Xmodem option to provide error checking. After about a quarter of the file was downloaded, everything stopped with no reason given. I then was forced to reload the system, cancel the program, reinitialize the old recording file, and establish a new one. I tried several times, without success, to get the entire file down. The program died in the same place every time. I was able to use another version of Xmodem with another terminal program and receive the entire file accurately. It might be that the problem is linked to the mainframe from which I was downloading. It is also possible that an intermittent software bug or incompatibility is to blame.

Another problem I encountered relates to volume labels. It seems that if you neglect to initialize a disk with a volume and filename under ProDOS, you can't get back to the main menu once you have opted to use Xmodem. I am sure that this problem has to do with the fact that Xmodem is a third-party program and that the facilities can't be made accessible while in that mode. The manual gives ample warning about this difficulty, but not so the tutorial disk. There isn't even a section on the disk describing the Xmodem protocol. This programming and documentation oversight is unfortunate.

In Spite of It All

I have found using the Apple modem and the Access II program both enjoyable and frustrating. It's likely that some of my frustration stems from a lack of experience with ProDOS. This is a situation that will be faced by many an Apple user, however. In general, the modem has functioned well during the time I have been using it. My friends are even getting used to the occasional high-pitched squeal they hear whenever they call me on voice. Aside from odd and sundry software incompatibilities, the only complaint I have with this modem is its power-supply lead configuration.

In spite of these niggling complaints, I think Apple's new modem represents a cost-effective way to get involved with computer communications. And, when coupled with the company's new Access II software, this modem supplies a host of features demanded by the most experienced users of remote databases and information services. ■

AT A GLANCE

Name
Apple Modem 300
and Apple Modem 1200

Type
300-bps and 1200-bps modems

Manufacturer
Apple Computer Inc.
20525 Mariani Ave.
Mail Stop 23AD
Cupertino, CA 95014
(408) 996-1010

Features
Serial, binary, and asynchronous data format; manual originate and answer, automatic originate and answer, and auto-dial operating modes; half-duplex or full-duplex on two-wire switched telephone channels; 0 to 45 dB dynamic range in full-duplex; bit error rate less than 1 in a million bits on all lines meeting Bell Tariff 3002 (standard voice grade) channel specifications, with no impulse noise or line interruptions; 13.65 by 23.18 by 3.18 centimeters

Power Supply
Three-pronged outlet-mounted power modem capable of 8 volts AC rms and 500 mA maximum current

Price
$235 for 300 bps, $499 for 1200 bps

Audience
For modem users with multiple needs and at least moderate experience

(continued from page A16)

direct method of obtaining color with MousePaint. You select one of the colored patterns from the array at the bottom of the screen (including the four Apple colors and a few lighter patterns), and then one of the filled shapes (square, circle or oval, rounded corner rectangle, curved or straight polygon). The inside of the shape will be filled with the color or pattern, and the border will be black in the line thickness you choose from the assortment at the left. If you choose the dotted border, the shape will not have a black border.

Because of the peculiarities of Apple's high-resolution color display, if you drag a colored shape left or right one pixel, you will change its color to the complementary one. Since the patterns are constructed from an undocumented data array, it might be possible to change them, but MousePaint has no pattern editor as MacPaint and the Gibson sysem do.

The speed of most of MousePaint is truly amazing, but filling shapes is slower than in other graphics programs. It also needs a separate paint-can icon. Circles or ovals are drawn to fit inside a rectangular box you outline by specifying opposite corners; I prefer the method of specifying the center and radius as in the Micro Illustrator program that comes with the Koala Pad or Powerpad.

Polygons seem to have a limit of 63 sides and an arbitrary length, because without warning they suddenly finish drawing themselves. I'd like to see MousePaint use some alert boxes in cases such as this.

Fatbits, available from the Aids menu, is really impressive. With it you can zoom in on a 32- by 19-pixel black-and-white area of your picture; with the mouse I felt much more secure in this mode than with devices such as the pen. I found one bug here. I was not able to reach the far right column of the page (about 7 pixels) from Fatbits. A small area in the upper-left corner automatically shows what the whole screen would look like if it were not enlarged. Once, without realizing it, I left the grid mode turned on. This lines up everything along straight lines. Thereafter, nothing seemed to work right in Fatbits. MousePaint needs some way of checking, dimming, or flashing your current choice on its menus, just as MacPaint or the pen programs do, so you know which mode you're in.

Light-Pen Software

The Gibson light-pen software released by Koala in early 1984 contains four separate programs on two disks: Pendesigner is almost identical to what Gibson earlier called Multidraw 1.0. Penpainter includes the Pentrak 3.0 subroutines and what were earlier termed demonstration programs, plus Penanimator, a simple animation editor, and Penmusician, similar to Music Construction Set.

The Pendesigner program, albeit only black and white, is the most powerful and interesting of the Gibson programs. Its advantages are two: deck filing, with up to four cards to and from which you can transfer parts of your picture, and the ability to link your pictures to the Penpainter programs on a separate disk. These also allow you to conveniently add uppercase text or fill your artwork with color or patterns.

The Penpainter user interface has been greatly improved by partially emulating Apple's pull-down menus (I would call them "pop-down" since you don't have to hold a button down to use them). By no means do they use the windowing technology that MousePaint exemplifies; you can't move them, size them, or put them away. You must also press a key to select your menu choice. Gibson allows you to draw on the whole screen: just wiggle the pen back and forth to make the menu bar disappear or reappear!

While the previous Gibson software suffered from a lack of uniformity, the present update with its regular command system is much easier to use. Most of the Pendesigner's filer, however, retains the somewhat confusing "infoflow" diagramatic interface of the original Gibson design. Icons are difficult to recognize when there are so many of them.

I found it somewhat harder to select from the Gibson menus with the pen, even when it was in perfect calibration. I had to place the pen exactly in the middle of the required area or else the next selection was read. The system makes you confirm or abort your choice. Also, there are some maddening audio prompts.

Some of the icons in Pendesigner are relatively clear. For example, the sketch, line, and rectangle work much the same as in MousePaint. There is no circle icon in Pendesigner, although Penpainter has one, plus 3-D boxes. The grid mode ac-

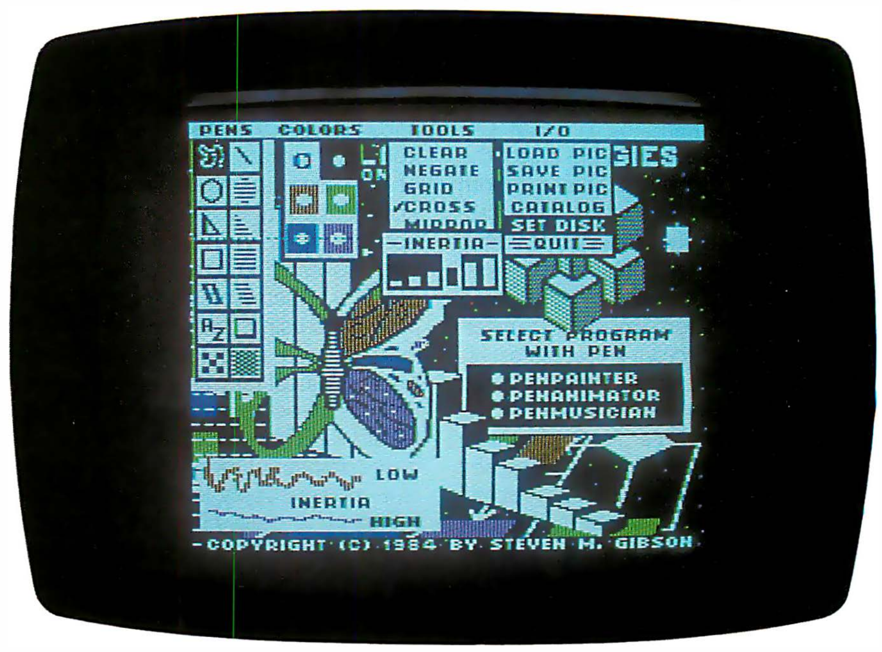


Photo 5: *Gibson's Penpainter program has "pop-down" menus and icons, but you can't move the windows. To remove them you shake the pen at them. Only one shows at a time—to display them all here I had to repeatedly reset and capture the Apple screen.*

tually puts dots every eight pixels on the screen, so it is easier to use than MousePaint's invisible grid. The tracking crosshairs and cursor color options are not necessary with the mouse but are essential with many backgrounds here. On the other hand, the white and black dots in the upper right-hand corner of the menu are really used as an eraser. You paint over the black dots with white to erase them. That is much slower than with the big gum eraser in MousePaint.

The zoom mode in Pendesigner enlarges the high-resolution screen so you can work on a 40- by 24-pixel area. As in MousePaint, the dots appear only in black and white. In Pendesigner you can produce only monochrome pictures, but it is possible to transfer pictures from and to other Gibson programs that use color. I found toggling the dots on and off much slower than the corresponding pencil in MousePaint because it takes time to accurately locate the cursor and press a key for each dot. In MousePaint and in Gibson's earlier Easy Edit you could just hold down the key or button. Moving the cursor is easier in Pendesigner because of the "slewing" function, which moves the whole screen as you move the pen and hold down the space bar, paddle button, or open-apple key. No other tools work in Pendesigner's zoom mode, unlike in MousePaint.

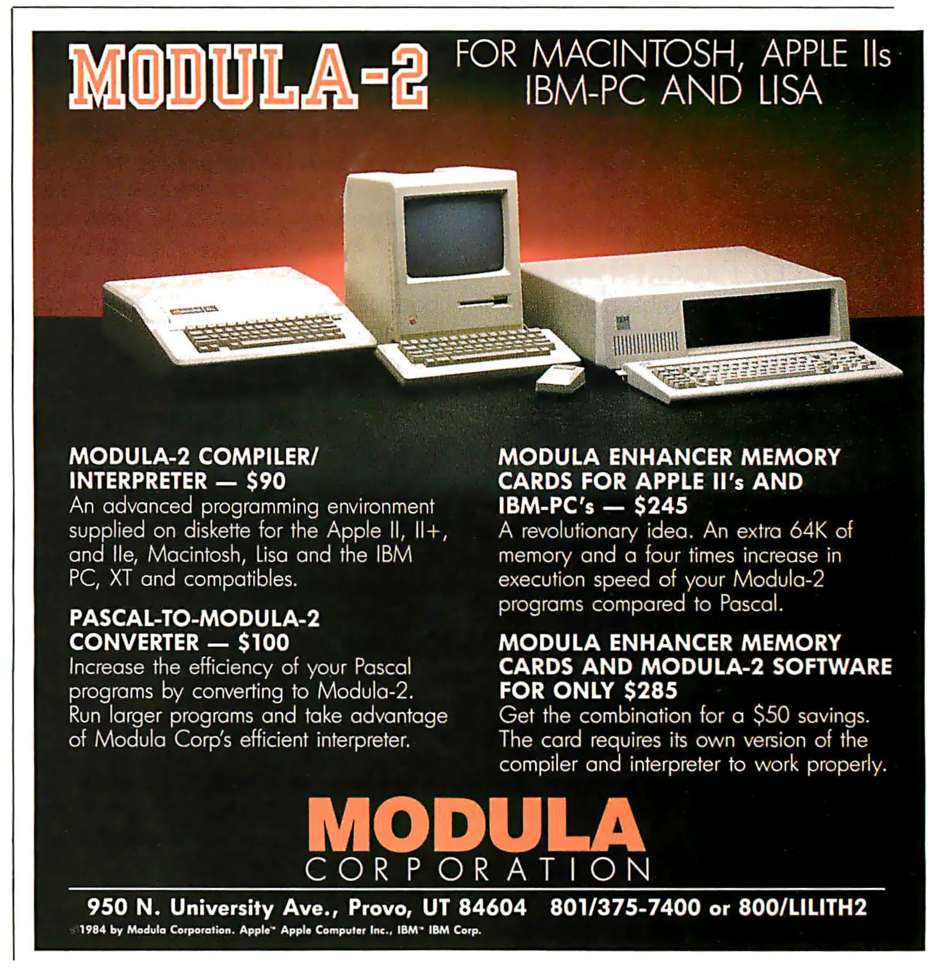
The deck function makes Pendesigner's minor hassles worthwhile. Koala supplies sample decks of engineering and architectural symbols and some simple font styles. You can make up your own "clip art." It works just like MousePaint's editing function, but decks of four cards can be saved and brought in from files separate from the picture you're working on. It won't work unless that part of the picture is smaller than a card. Just be aware that decks are saved in differently formatted files (a distinct filename suffix would help) and must be retrieved with that function in the filer; otherwise, the program may crash. One bonus with Pendesigner is that you can stretch and shrink straight lines with the editing frame.

Penpainter has a beautiful array of patterns, and you can make your own very easily with the supplied pattern editor. Only black outlines can be filled,

(continued)



Photo 6: *You can add your own patterns to the pattern editor's collection.*



but if you draw in colored lines you can change them to black. This takes some experimentation. If there is even the smallest break in the outline, the filling will leak all over the screen.

The patterns must be on the disk you have Set from the menu; if the program can't find the pattern file, it gives an unclear error message and won't let you proceed.

Freehand sketching, available from the Penpainter's Pens menu, is notable for its ease of use and a few sophisticated features. You can draw lines in any of the six Apple colors, which is hardly possible in MousePaint. These are shown in a Colors palette, but even more shades are reached through the pattern-fill icon on the Pens menu. The adjustable "inertia" feature, chosen from the Tools menu, averages the dots for you so you can make smoother curves. Likewise, the simple mirroring option is often useful. You can use this program to trace through a transparency held against the screen.

One avoidable problem with Penpainter is that hitting Control-C during the program causes it to end. You must keep the IIe Caps Lock key down. Text is only uppercase and not proportionally spaced, but you can make up your own character sets (no instructions are given, however).

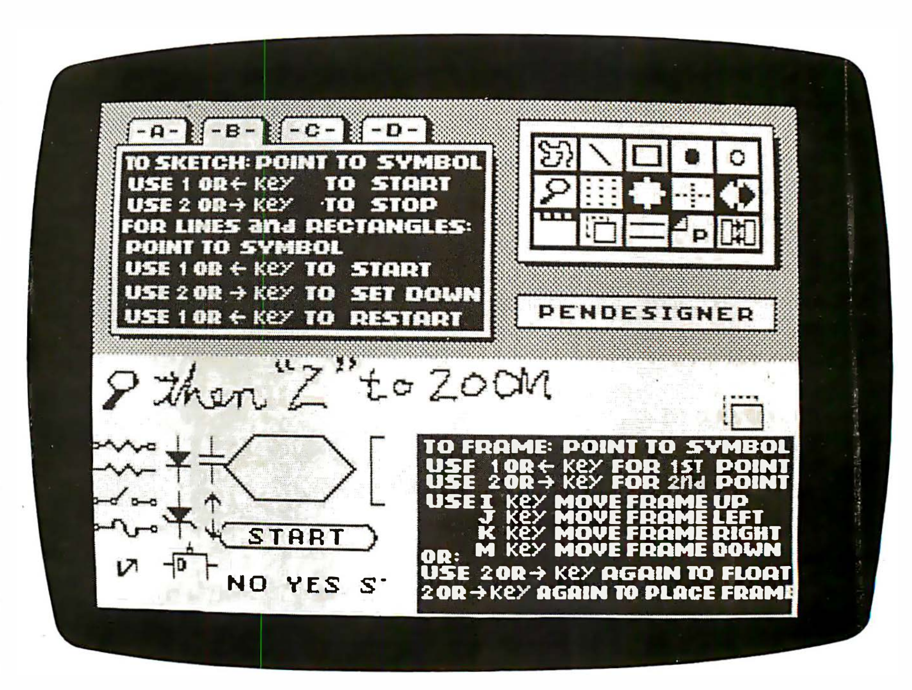


Photo 7: *Pendesigner menu at upper left has many icons. Bottom shows some cards supplied with system; you can add more. Space bar toggles full-screen display.*

Advanced Programming

MousePaint and the Gibson demonstration programs are fun and easy to learn, but the real value of the mouse and the pen may lie in how easily they can be accessed from your own programs.

I expect Apple to release a new character generator ROM for the IIe, a 6502 graphics kernel toolkit (much like Macintosh's QuickDraw), and drivers for Pascal and Apple III.

It is simple to put the mouse in BASIC mode: just PRINT CHR$(4) "PR#4" (assuming it is in slot 4) and PRINT CHR$(1), which zeros the mouse position. To output to the screen at the same time, you need to add a PRINT CHR$(4)"PR#0". You can easily INPUT mouse data and draw to the screen. Sample programs in the appendix are helpful, but you'll have to move the mouse slightly, just as you run MOUSE.MOVE, or else it will never seem to do anything.

Following a discussion in Appendix B of the mouse firmware is a machine-language program illustrating some of the routines presented. The program is a bit strange because it uses self-modifying code and does not use interrupts. Firmware routines include Setmouse, Readmouse (passive mode not using interrupts), Servemouse (for interrupt handling), Clearmouse (zeros position), Posmouse (sets position to specific values), Clampmouse (limits boundaries of mouse), Homemouse, and Initmouse.

The Pendesigner 3.0 routines on the Gibson disk are actually machine-language subroutines experienced programmers can call from Applesoft BASIC programs with the unique ampersand hook at $3F5. The manual does not explain in any detail how to do this programming (you can type some in directly from the keyboard, too) but does list the routines and what they do. The programs are rather extensive; you can fully control the pen from software. You can specify any of Apple's screen pages to work on, and many of the commands will be familiar from Applesoft's graphics commands. The rough-terrain tracking and glitch-filter routines are especially sophisticated.

Documentation

Here and there, the AppleMouse II users manual shows evidence of haste in completing the text. On the whole, however, it measures up to Apple's new and excellent documentation standards. Its photographs are good, its typography clear, and its approach level-headed and nontechnical. I have already pointed out some errors, and a sheet of corrections and additions accompanies the manual.

Koala's manual is directed to the beginner and is short. Koala has deleted some of the wordiness of Gibson's first manual. You may not find enough detail to let you write your own programs, but you can list the Gibson programs, which may give you some suggestions.

Neither manual has an index, and both could profit from more examples.

Conclusion

I made far fewer errors with the mouse than with the pen, and MousePaint appears to be easier to learn to use. MousePaint requires less interaction with the keyboard and less movement from one screen to another. The Gibson system has some very nice tools not yet available with the mouse and much better color. But mouse buyers can expect more software support in the future.

Though they have little place so far in business, both the mouse and the pen serve as examples of the new user interfaces that will be bringing microcomputers to more people. ■

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First Class Peripherals. And what an alternative we offer! Our message is a simple one: *We have the finest, easiest-to-install 10-megabyte Winchester hard disk subsystem in the industry today, bar none. And we have it, direct through the mail to you, for the best price. Period.*

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Inside, that quality look is matched by the highest quality components, from the half-height 10-megabyte Winchester, to the best-selling intelligent controller in the business, right down to the power supply. The most comprehensive component-to-component testing ensures first class reliability, day-in and day-out. And advanced internal design has allowed us to build these components into this modestly-sized casing in such a way that we've even eliminated the need for a cooling fan.

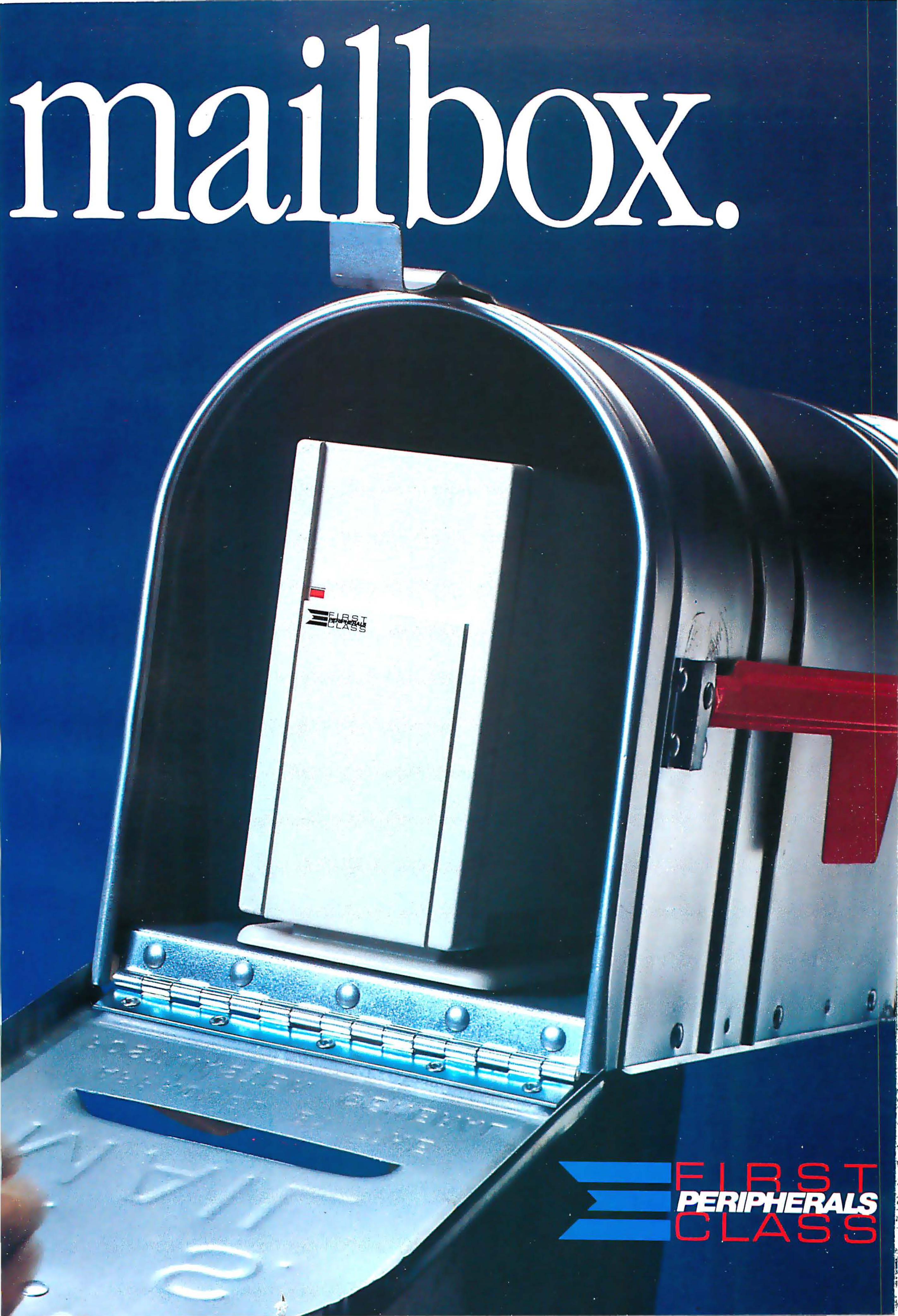
From Hotline To Swapline, A First Class Commitment To Support.

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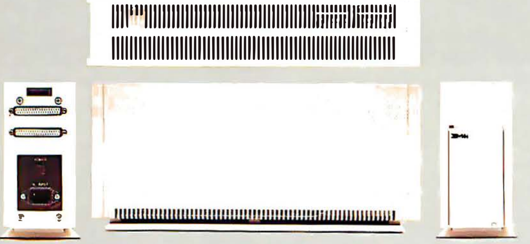
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FIRST PERIPHERALS CLASS

The Sider:
A First Class Engineering Achievement.

PUT ON YOUR SPECS AND READ OURS.



The quality of a product is often made or lost in the fine print, the nitty-gritty engineering details. That's why we're proud to say that the technical-at-heart can indeed take heart at how we put together The Sider.

Take a look at these specifications.

Operating Systems Supported
- Apple DOS 3.3; ProDOS™ 1.0; Microsoft CP/M® 2.23; PCPI™ CP/M 1.0, 1.5, 2.0; Apple Pascal 1.1, 1.2

Specifications
- Formatted Capacity: 10 MB
- Sectors/Track: 32
- Bytes/Sector: 256

AC Power Requirements
- Source: 100-126 VAC, 220-240 VAC
- Line Frequency: 50/60 Hz (±2%)
- Power Consumption: 40 W

Environmental Range
- Temperature—Operating: 10°C to 40°C; Non-Operating: −40°C to 60°C
- Relative Humidity: 20% to 80% (without condensation)
- Altitude—Operating: −300 ft. to 10,000 ft. (−91 m to 3,048 m); Non-Operating: −300 ft. to 30,000 ft. (−91 m to 9144 m)
- Shock—Operating: 5 g; Non-Operating: 40 g
- Vibration—Operating: 2 g; Non-Operating: 3 g

Physical Dimensions
- Height: 7.5 in.
- Width: 3.375 in.
- Depth: 16.0 in.
- Net Weight: 11 lbs.

Feature/Benefit Brief
- Automatic data error detection and correction for high data integrity and faster system throughput.
- Internal diagnostics for increased subsystem reliability.
- Field-proven Winchester disk technology for better data integrity.
- Small footprint for increased workspace dynamics.
- Regulatory agency approval, meeting FCC Class B requirements.
- Menu-driven installation for increased user friendliness.
- Backup and restore utility for most operating systems, by volume, by operating system, by file, and by use of wild card backup.
- Flexible partitioning for optimizing operating system file sizes.
- Built-in modular drive expansion capability.
- Direct boot from hard disk, eliminating floppy drive booting.



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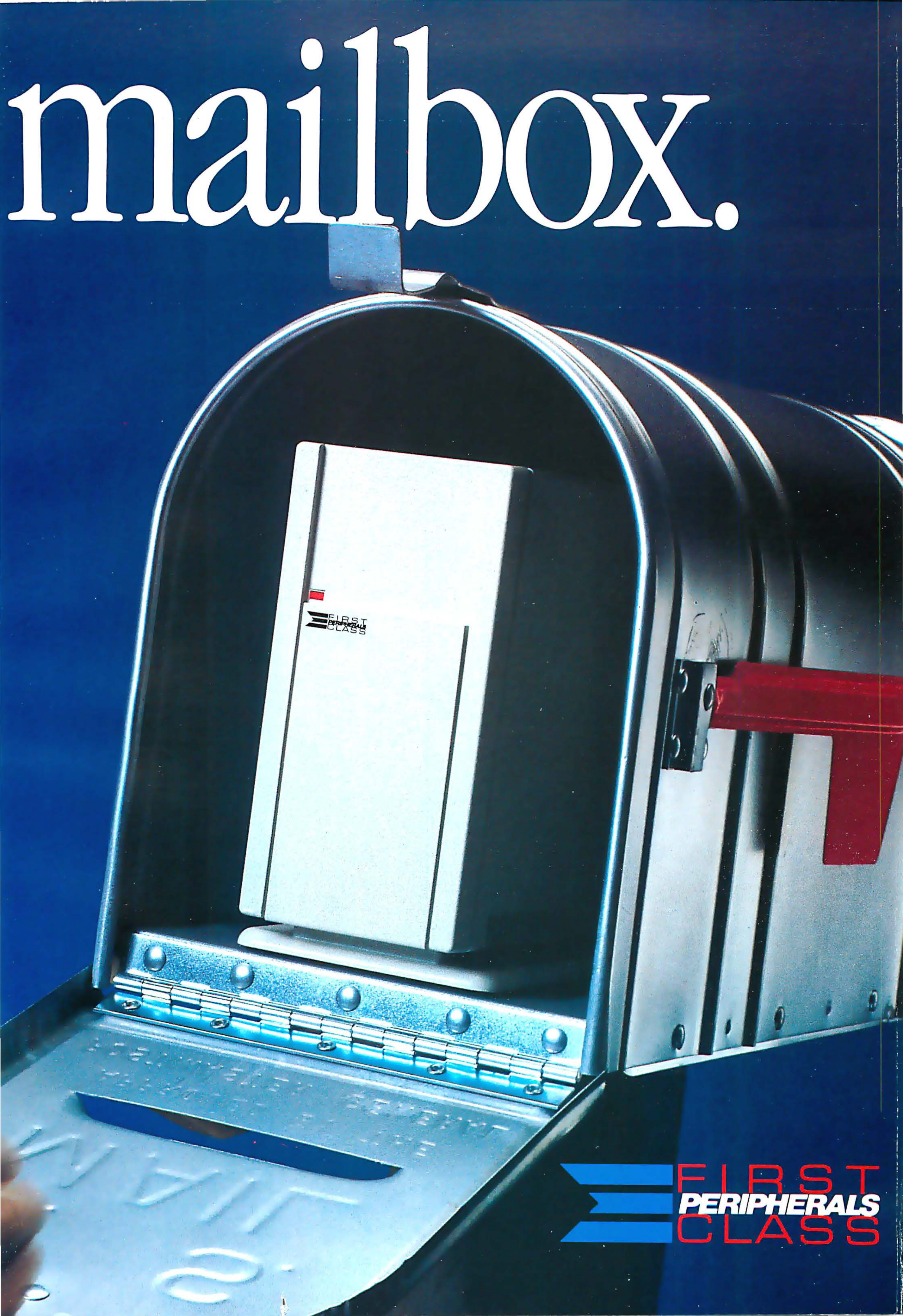
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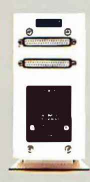
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PART II

THE APPLE PERSPECTIVE, VIEWS FROM WITHIN



ILLUSTRATION BY ROBERT TINNEY



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It has a high speed (6MHz) Z-80 that runs CP/M up to three times faster than lesser boards. Plus 64K memory and 80-column display that fits the IIe auxiliary slot and acts like Apple's own Extended 80-column Card. So it works with CP/M, Apple DOS and ProDOS programs, too.

Microsoft BASIC is built-in, so it's compatible with more Apple CP/M software than any other board on the market: Thousands of the juiciest business programs including dBase II,® WordStar® and sophisticated Microsoft languages like FORTRAN-80, COBOL and BASIC Compiler.

It also has a new low price.

Juicing up the performance of computers is nothing new for us. We invented the SoftCard and make versions for the entire Apple family. We wrote Applesoft for the Apple II.

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CONDUCTED BY GREGG WILLIAMS AND ROB MOORE

An interview with Steve Wozniak

Steve Wozniak is the designer of the original Apple computer and one of the cofounders of Apple Computer Inc. Here Steve speaks at length on a variety of topics that range from the hobby activities that led to his design of the Apple I to current issues at Apple Computer. His frank comments and criticisms provide a glimpse into the workings of Apple Computer from a true insider's point of view. This is the first part of a two-part article.

BYTE: *We've heard that you designed the Apple I while you were working at Hewlett-Packard in 1975. Can you tell us what you were doing before that: what lead up to the creation of the Apple I?*

Wozniak: I have been interested in electronics and computers all my life. In my high school days, I studied TV circuits and I designed about 50 computers on paper, but I couldn't afford the parts to build them. In 1970, most people couldn't afford a monitor, so I designed video outputs that plugged into an oscilloscope and had the oscilloscope draw letters on the screen.

I had also been studying software. I wanted to know how to write compilers for languages like FORTRAN or BASIC, so I studied and kept notebooks. It was all self-taught and on paper, but I never got a chance to try it out.

I took three years of college toward a computer science degree back when only a few colleges were starting to offer it as an undergraduate curriculum. My third year had been at The University of California at Berkeley.

I originally planned to take a year off from Berkeley after my third year to earn enough money as a technician for my final year of college. But my career kept advancing. I was hired by Hewlett-Packard, made an engineer there, and I started developing better design expertise. I got into chip layout and things like that, and basically my career kept moving, my interests in life were changing, and it was too far to commute to Berkeley. I tried San José State but I didn't have the time available and it wasn't compatible with my first three years of college. It would have taken four more years to get my degree. So I never got a degree.

I was still an electronic hobbyist. I lost interest in minicomputers during the next three years, because I was doing calculator chips at HP and projects on the side at night.

I saw a Pong game in a bowling alley. So I went and designed my own. I designed the Breakout video game for Atari. I was just constantly involved in electronics as a hobby. At Hewlett-Packard we were pretty much just designing integrated circuits.

Around that time the Homebrew Computer Club got started and I happened to get directed to the first meeting by accident. I started discovering a bunch of high school kids who knew all about microprocessors and assembly language, and it was the stuff I had done up until three years before in my life. My whole life had been in minicomputers. All of a sudden, I started realizing microcomputers are the same as minicomputers, and I understood them.

BYTE: *You mentioned that you designed the Breakout game for Atari. How did that happen?*

Wozniak: Steve Jobs was working for Atari at the time. Nolan Bushnell was really annoyed because all their new games

(continued)

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> *'I didn't want to pay to use somebody else's computer, so I decided to design my own.'*

were coming out at 150–170 chips. He wanted low chip counts to reduce costs, and he had seen a version of Pong that I had done, that only used about 30 chips. He appreciated that. So he said if we could design a hardware Breakout in under 50 chips, we'd get 700 bucks; and if it was under 40 chips, we'd get $1000.

Atari didn't put us on a time schedule; Steve did. I had to do it in four days because Steve had to catch an airplane to Oregon. I was the designer—the engineer—and Steve was a breadboarder and test technician.

We gave them a working breadboard for it. My first design was 42 chips. By the time we got it working it was 44, but we were so tired we couldn't cut it down. So we only got 700 bucks for it.

The Apple I

BYTE: *How did you get to the point of designing the Apple I?*
Wozniak: I had worked my way up through software using a terminal on a local time-sharing system. Sometimes I'd call it from work, but I wanted to do it at home. I eventually designed and built a TV terminal and a modem so I could call this computer and play games. I was a true hacker. I started getting on ARPA-net and accessing computers all around the country. BYTE was the first magazine to get started, and I bought issue #1 at the newsstand.

I didn't want to pay to use somebody else's computer, so I decided to design my own. I wanted to have it all in one place, and I already had a terminal, so I was part-way there.

I sat down and wrote the BASIC first, and that took a lot more time than the computer design. Once it was written, I had to build the computer. I had designed a simple 6800-based computer, but the actual choice of processors was dictated by what I could afford. At the time, most microprocessors cost hundreds of dollars, but you could buy a 6501 over the counter for $20, and a 6502 was $25. So I bought a 6502, built the computer, and soldered one of my small TV terminals right onto the same board. It was a small computer with a small terminal, but it had good capabilities.

In our lab at Hewlett-Packard we had a desktop computer called the 9830 that ran BASIC. It was designed for the scientific community and cost $10,000 so it wasn't a personal computer, but you could run BASIC as soon as you sat down. That was my goal with the Apple I—you could sit down, turn it on, and start typing.

That was the main thing about the Apple I. Its characteristics were largely centered on its video terminal capability. In those days, the most common input/output mechanism was the ASR-33 teletype. It had been a standard for 10 years, and the minicomputer companies had only recently started using video terminals. So I had lots of experience using teletypes, and now I could do it in video with my terminal.

In 1975 video terminals were designed with shift registers because there were no cheap RAMs. You'd set up a bunch of shift registers and keep shifting them around to send text to the TV screen. So the Apple I was slow. It could type out 60 characters a second—one character per scan of the TV screen. My motivation was totally to save chips, not to add features.

BYTE: *Was the Apple I really a full-blown computer?*
Wozniak: Yes, but its features were a little bit different than the Apple II's and other personal computers that followed. It was slow, and it was text only, but it was a lot faster than the teletypes we were used to. They could only type 10 characters per second. TV terminals were just starting to get popular in those days.

BYTE: *Weren't they still fairly expensive?*
Wozniak: Yes, but I had to be cheap because I didn't have any money. I used the oldest, cheapest surplus parts I could find. Don Lancaster had written an article called "TVT1" for *Radio-Electronics*, and it was the big hobbyist article of the day. He had a humongous design that used tons and tons of parts and gates, but it was a poor design. I was into tight, clever designs to cut chips down, so I was flexible about the video timing. I knew from my high school days that TVs are designed with a lot of slop. Even if my timing was a little bit off, it would still work with most TVs and monitors.

BYTE: *So you didn't worry too much about precise timing?*
Wozniak: No, I was in a very hobbyist realm. I wasn't designing a product, just something that would work at home on my own TV. The computer itself used a 6502 processor interfaced to the terminal through a parallel interface chip called a PIA. It could also read a keyboard, so I bought a surplus keyboard that was advertised in an electronics magazine for $60. It emulated an ASR-33 teletype and did everything I wanted it to do, so I interfaced it.

Memory was my main problem. The only surplus RAMs available at the time were 2102s—1K static RAMs. I had the computer designed and the BASIC written, so I borrowed a 4K 2102 static RAM board from a friend so I could test it out. I got my BASIC going with that, but I wanted to use dynamic memories because you could cut the chip count way down.

Steve got intrigued with all these ideas and one day he asked me, "Why don't you use these new 16-pin dynamic RAMs?" I had looked at them in my work at Hewlett-Packard, but they were new and I couldn't afford any parts that didn't come my way almost free. I'm a little bit shy, and I didn't know any of the reps, but Steve just called them up and talked them into giving us samples. I jumped on it. I thought it was a great part because you could replace 32 chips on a board with just eight. It was a little more difficult to use because you had to multiplex the row and column addresses and that cost me one or two chips. But I was very happy because it was TTL [transistor-transistor logic] compatible and I could save a lot of board space because the parts were so much smaller. My whole goal was to make it as small as I could. I now had a little computer on one board about six by eight inches that

'Showing off Breakout on the Apple II at the Homebrew Computer Club was the most satisfying day of my life.'

I could take down to the club and show off. It was only 30 or 40 chips and it could run BASIC. People would look at it. It was unexpected.

BYTE: *So how did Apple Computer actually get started?*
Wozniak: Steve and I had both been going down to the |Homebrew Computer| club and giving out schematics for the computer and the terminal, even going over to people's houses and helping them build and test the computers out. Steve said, "Look, people are interested in what you've got. Why don't we make a PC board, have it silkscreened so they know what parts to plug in, and sell it at the club?"

We had about 500 members in the club, and I thought that maybe 50 people would buy it. It would cost us about $1000 to have the board laid out, and each board would cost us about $20. So if we sold them for $40 and 50 people bought them, we'd get our $1000 back. It seemed pretty doubtful. But Steve said, "Well, yes, but at least for once in our lives we'll have a company." So Steve sold his van and I sold my HP calculator to raise the money to make the PC boards.

Right away Steve got a big order from a local computer store to supply completely built computers. They ordered something like 100 units at $500 each, to retail at $666. It was unbelievable—a $50,000 order. We were in business.

All of a sudden we needed about $20,000 to buy parts. Steve went down to the local parts suppliers and we filled out financial forms. They looked at our purchase order, made phone calls, and really looked into our customer's credit. In the end, they gave us the parts with 30 days' credit. We had everything set up to build the computers and deliver them in 10 days, and it worked out great. We delivered the computers, paid off the parts suppliers, and only had to borrow $5000 from a friend, Alan Baum, and his father.

BYTE: *How many Apple Is did you actually sell?*
Wozniak: We manufactured 200 of them and sold all but 25 over a period of nine or ten months.

BYTE: *When was that?*
Wozniak: In 1976. It was first demonstrated running BASIC in late 1975, and Steve suggested forming a company in late 1976. We formed an official partnership in March. We had a third partner at the time who had 10 percent, but he sold out for $800 because he thought we weren't going to go anywhere except into debt, and he was the only partner with money.

BYTE: *Just to put four or five stories to rest, where did the name Apple Computer actually come from?*
Wozniak: It came out of Steve Jobs's head, and he's a sort of private person, so I can't say what led up to it. He came up with an inspiration. He was working from time to time in the orchards up in Oregon. I thought that it might be because there were apples in the orchard or maybe just its fructarian nature. Maybe the word just happened to occur to him. In any case, we both tried to come up with better names, but neither one of us could think of anything better after Apple was mentioned.

BYTE: *Hewlett-Packard didn't want the rights to the Apple I. You designed it while you were working there. Did you offer it to them?*
Wozniak: Yes. There were a few of us in the lab at HP who were interested in microcomputers. We had proposed it to the lab manager. We sat down and had a meeting, and worked out on paper how we could have a little $800 machine that could run BASIC and connect to a home TV. Now this guy had been the project manager of HP's 9830 desktop BASIC machine, and he had been through a lot of these issues. He knew why this couldn't be an HP product, and he was right. Hewlett-Packard just couldn't do a hobby product—they just couldn't get into an evolving market when it was too young and unforeseen. So he turned it down and I got a legal release. A funny thing happened. After we started shipping Apple Is, our calculator division at HP started a little 8-bit processor project called Capricorn. I had already done most of the stuff they were doing, but they wouldn't let me work on that project.

BYTE: *Can you summarize the characteristics of the Apple I?*
Wozniak: It used the 6502 and included 8K of RAM by the time we put it out as a product. You could load BASIC into 4K of memory and you had 4K left over for your own BASIC programs. We supplied the boards completely put together and it had a video connector, but you still had to connect a video monitor on your own. You also had to get a keyboard and wire it into a 16-pin DIP connector. We built a power supply onto the board, but you had to connect two transformers for 5 volts and 12 volts. It had no speaker, no graphics or color. It could just display text at 60 characters per second.

BYTE: *The display wasn't memory-mapped?*
Wozniak: No, it was just a computer with a built-in video terminal. You could hand-wire certain addresses to read the keyboard, write to the video terminal, and select addresses for 4K memory bank 1 and bank 2. It had one external card connector, and we quickly filled that with a cassette interface card. It also had a side connector where we could theoretically add something later to expand it. The idea was just very small and simple, and it was all on one board.

BYTE: *Was there a monitor in ROM?*
Wozniak: Not really. In those days PROMs were very expensive, so I just used two small 256 by 4 PROMs to give me 256 bytes of ROM. I wrote a little program that would let you type in hexadecimal codes, examine a range of memory, or run a program at a particular address. Those three functions fit in 256 bytes.

(continued)

THE APPLE II

BYTE: *How did you make the transition from the Apple I to the Apple II?*
Wozniak: We were selling Apple Is and we were just having fun and getting known. It was the most incredible thing we had ever done in our lives. I was still working at Hewlett-Packard and just moonlighting at Apple to test out boards, write more programs, and design a cassette interface so you could load BASIC in just a few minutes. [*Before the cassette interface, you had to type in the entire 4K BASIC interpreter by hand, in hexadecimal....* **R.M.**] I had taken the machine down to the Homebrew Computer Club for its official introduction and pointed out its features. I got asked a lot of questions—people wanted to know if it could do other things.

At the time, Cromemco had just come out with a board called the Color Dazzler that did color graphics on S-100 systems. We had also had a demo, at the club, of a minicomputer running a display of a clock on the screen in color. During one of my times at Atari with Steve, I had designed a little seven-chip circuit to do color on a TV screen and it worked. So I started working on things that I wanted to add to the Apple I. I was thinking about clever color circuits and how to cut the chips down.

Remember, I had a computer with its own memory and a terminal with the display memory in shift registers. So I started thinking how I could combine parts into one—to somehow get them both to use the same memory. I finally worked out a design where a small part of the main memory was used as the terminal's video memory.

Eventually I got the whole machine done. It did everything that the Apple I did, except the display was in main memory so you could change any location on the screen instantly. I had built-in color, and EAROMs [electrically alterable read-only memories] were getting more common, so it had software built in to make it operate like a terminal. So it had color, it was very fast, and it was still cheap. In the end it was about half as many chips as the Apple I and it was many times better.

BYTE: *Was the designed-in color low resolution or high resolution?*
Wozniak: At first it was low-resolution color. Basically it could output characters in two different ways, either as text or as colors. I actually had to modify our horizontal video rates to be a little different from the NTSC [National Television Standards Committee] standards, because NTSC was not designed for digital video.

Once the computer was done, I started writing routines for the ROMs. I wrote terminal software so the characters would display in rows, from left to right and move down to the next line for a carriage return. I expanded my monitor routines to do more than just load hex, display memory, and run programs. I added the cassette routines because I knew they were going to be important. Eventually I started adding fancy features like a disassembler and the ability to split the screen into different windows. I would just go down to the club every two weeks and show off the latest routines I had done, because it was impressive. It wound up being a 2K monitor with graphics routines and everything included.

All my thinking from the Apple I days was carried over into the Apple II. Most people could not afford a color monitor, so it had to work with a home TV. A home TV could only display 40 characters across the screen, and I had to do what a TV could display. It was interesting because the technology defined the product rather than the market defining the product.

BYTE: *What caused the odd mapping of the graphics addresses?*
Wozniak: I had horizontal and vertical counters in the video circuits, and I had to map them into the display memory addresses. If you think about it, it's simple to have a perfectly linear address space. You take the vertical count times 40 and add it to the horizontal count. But it took three 7483 adder chips to do that, and I was looking for ways to save chips in the design. I figured out a couple of tricks that let me do it with just one adder, so I was able to save two chips; that helped others at the Homebrew Computer Club.

Also, I assumed that the user would just send characters to the screen through the terminal routines in the monitor. He would never see the odd addressing. I just wanted to play games and run BASIC. I didn't perceive that anyone would want to address the screen directly. Fortunately, only the vertical addresses were out of order, and there are a lot of easy ways to handle that so it doesn't slow things down.

BYTE: *How did you come up with the scheme where each byte only displays 7 bits, and when did the high-resolution graphics arrive?*
Wozniak: I had used the cheapest parts available, and a 5 by 7 character generator was the only cheap one in 1975. So my characters were five dots across and they fit into a 7 by 8 matrix. From my experiments with color and my experience with TVs, I knew how much time was available to display data during a TV scan. I also knew that my master clock had to be a multiple of the color-burst frequency, so I used 14.31818 MHz, four times the U.S. color subcarrier. So with that clock, I just counted how many dots per character would get 40 characters on the screen. I could have used eight dots per character and displayed 32 characters per line, but if I tried to display 40 characters of eight dots each it would have been too wide to fit on the TV screen.

One day I mentioned to Steve that I had noticed something interesting in the video addressing. I could make a little change by adding two chips, and then I could just shift each byte out onto the screen and we'd have hi-res graphics. I wasn't sure that it was worth the two chips because I was very chip-conscious. But Steve was pushing for all the features we could get, so eventually we put it in. At the time we had no idea that people were going to be able to write games with animation and little characters bouncing all around the screen. It was a neat feature, so we put it in there. Well, now I had a computer that had color in roughly the size of the bricks in the Breakout game I had designed for Atari. I had written a bunch of assembly-language routines to draw spirals and zig-zags of color, and I would take it into Hewlett-Packard to show the engineers. Sometimes they would sit down and say, "This is the most incredible product I've ever seen in my life." Many people were saying that when they saw the colors, but it was not in BASIC yet.

I wanted to write Breakout. I knew I could do it in assembly language, but I hadn't put any graphics commands in the BASIC yet. I knew how to add commands, since I had written the BASIC, so I put in a command to plot simple color

Circle 679 on inquiry card.

squares and soon got to a point where I could draw a brick wall. Then I did a ball and wrote some routines to make it bounce around. Now I needed a game paddle.

I wasn't sure how to sense the value of a paddle. I didn't want to put in 20 chips or anything expensive. So I found some little timer chips—NE555 timers. They were very cheap, but they could sense the value of a pot [potentiometer] by controlling their timeouts. There was also a larger one that was four 555 timers on one chip. So it was trivial. With a few resistors and capacitors I could read four paddles. As I got further into the game I needed sound, so I put a speaker in also.

Basically, all the game features were put in just so I could show off the game I was familiar with—Breakout—at the Homebrew Computer Club. It was the most satisfying day of my life when I went down there. I got a couple of high school kids to help me set it up, and I demonstrated Breakout—totally written in BASIC. It seemed like a huge step to me. After designing hardware arcade games, I knew that being able to program them in BASIC was going to change the world. All of that stuff is the essence of the Apple II.

BYTE: *We've heard that someone else helped you with the design of the I/O slots on the Apple II. Is that true?*

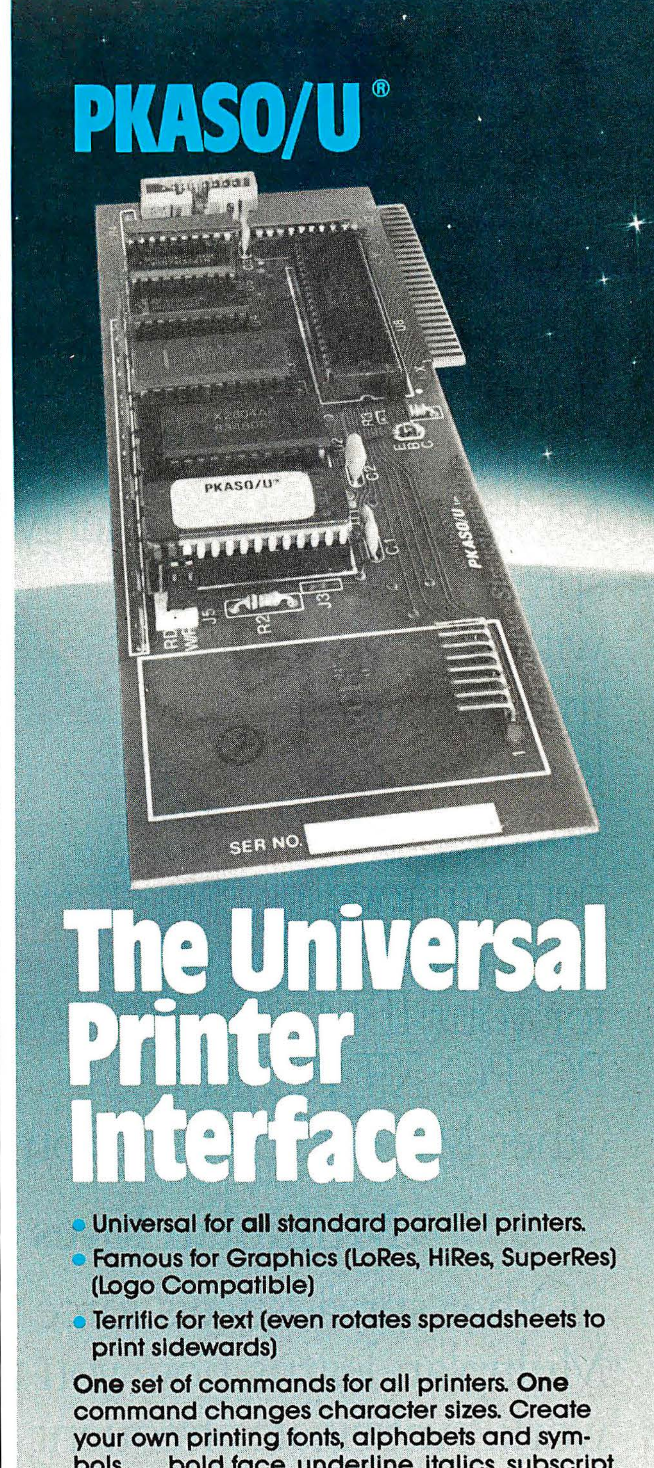
Wozniak: Yes. Many of the computers of the day had I/O card connectors, but they all required a bunch of address-decoding circuitry on each card. It was costly and required extra chips. I was into low-chip-count designs, and I wanted to have eight slots. So I was thinking of dividing part of the address space up between the eight slots and just using one decoder on my board to decode the eight different addresses. In that way, each I/O board didn't need three chips' worth of decoders on it.

Alan Baum helped a lot. I already had some address decoders on the board that decoded every 16th and every 256th I/O address. Alan realized very clearly that each card could have its own little 256-byte PROM on it and how they could all share a bank-switched 2K space. So I could just send two decoding signals to each card. Each board had 16 addresses for its I/O and 256 bytes of space for its PROM. Alan was the most constructive person in terms of realizing very clearly just how well the hardware-software interaction would work.

I saw one of Steve Ciarcia's articles in a recent issue of BYTE. He implemented a new voice chip design on an Apple II, and he said it was "because you don't have to decode it on the board." That was exactly the purpose behind the I/O decoding Alan and I designed. Oddly enough, he and his father were the ones who lent us the $5000 we needed in the Apple I days.

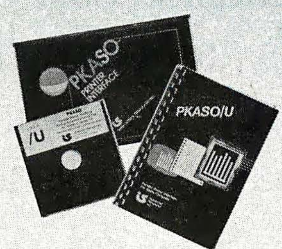
BYTE: *How did you raise the money to build the Apple II?*

Wozniak: By the time we did the Apple II, we had to build 1000 boards that cost $250 each. We needed $250,000 and we had nothing. Mike Markkula helped us write a business plan, and then he started perceiving that maybe this home computer market was really going to happen. He thought that home computers would hook up to your oven and refrigerator. Obviously this didn't happen, but he decided to join us as a third partner. ■



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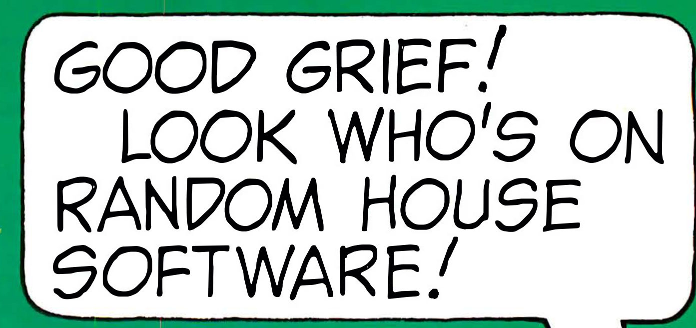
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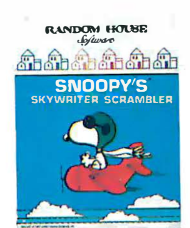
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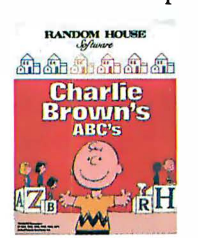
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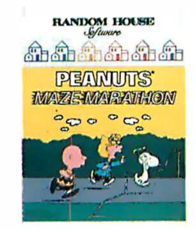
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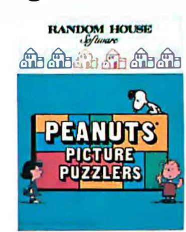
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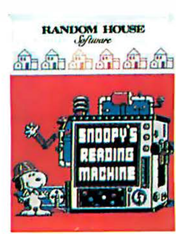
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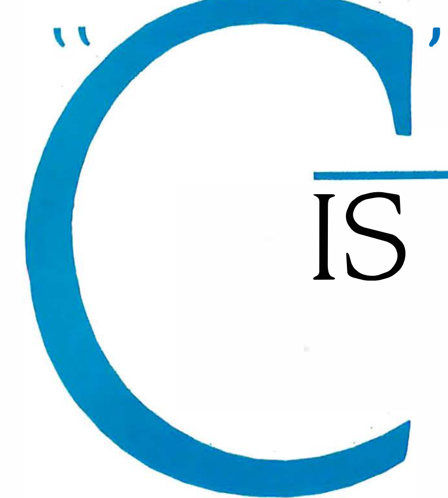


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"C" IS FOR CRUNCH

CONDUCTED BY GREGG WILLIAMS

An interview with Apple IIe and IIc design manager Peter Quinn

[Editor's note: *On March 16 and May 2, 1984, I interviewed Peter Quinn—first about the Apple IIe and later about the IIc. The Apple IIc had its roots firmly embedded in the IIe project, and parts of both machines were designed simultaneously. Here are some excerpts from these interviews. . . .* G.W.]

BYTE: *Were you in on the Apple IIe design from the beginning?*
Quinn: From the very beginning. I was originally hired [November 1980] to redesign the Apple III, to customize it—I'm an IC [integrated circuit] designer also. I worked on that for about six months. Then Apple approached me to manage. . . . I was the hardware design manager of the IIe and worked with the design team, including the industrial designer, the firmware people, and such. I brought that out and rolled right into this product— the IIc—where I was more like the engineering director in charge of hardware, firmware, product design, and disk drives.

BYTE: *I was particularly pleased by one of the first Apple IIe ads that showed both the II+ and the IIe and had the headline "Success/Successor." When you started out, in what ways were you attempting to make the IIe the successor? What were your design goals?*
Quinn: Well, you really have to go back to the history of the machine. Steve Wozniak started to design a custom, integrated Apple II—the project was called the Apple Annie—and the engineer he worked with at Synertek to do the custom IC was Walt Broedner. Walt was so impressed with Apple that, even after the project was cancelled, he tried to get a job here and subsequently did.

Walt always had it in the back of his mind to do a customization of the II. Management fought it for a year at least because they weren't into custom ICs. So he'd keep on proposing it and getting knocked down. Finally, there was this reorganization. With me being an IC designer and so forth, I backed him.

Walt partitioned out the machine (the IIe) and came back with the original plan, which was fairly close to what we have now. We all knew that we had to enhance the keyboard and give it 80 columns.

To do 80-column text, Walt mirrored the text page, which is at [hexadecimal address] 400. And that's all he did. It was a 1K mirror of the text page that, every other character, you bank switched. But then he was driving home one night and he said, "Hell, if I've got the flags to switch that memory area, why don't I switch the entire 64K area?" So the idea of getting 128K in the Apple II was an inspiration that fell out of that.

The video slot—the auxiliary slot, we call it now—grew out of Walt's wanting to get 80 columns and his interest in video—[high-quality] RGB color. (Broedner later left Apple and founded Video 7, a company that manufactures RGB cards.) Another reason for the slot was because the test engineering people wanted the signals available on the

(continued)

Gregg Williams is a senior technical editor at BYTE. *He can be reached at* POB 372, *Hancock,* NH 03449.

The goal was for the IIc to fit inside the standard size briefcase. . . .

IIe motherboard. The whole idea was to make the IIe as open a machine as possible by bringing out all the major signals to either the peripheral slots or that auxiliary slot.

BYTE: *How did the IIc get started?*
Quinn: The history of the two products was so intertwined. While Walt was designing the custom ICs on the IIe, marketing was. . .starting slowly to create [the IIc]. . .adding in the disk controller, the serial port for a printer [on the main board].

[Marketing] wanted to take some of the slots out and put in some built-in peripheral handling. And engineering was quite upset about that. They felt . . .we'd have to make it [Apple's next product] as much like a II as possible, only better.

So Walt talked with Steve Jobs. And Steve said, "Yes, I think you should do the IIe the way you had planned"—with the open architecture—"but if you want to do a focused product, then this is the one." And he painted out basically what you see now in the IIc, except it didn't have the built-in disk drive. It had its built-in mouse port and one serial port and a few goodies like that. At that time the computer was called VLC for "very low-cost." It was basically a computer and a keyboard.

Walt came back and did some more work on the customs [ICs] and he said, "What if I wanted to do both the machines in one?" Basically, he put the logic for the mouse-handling stuff [into the custom chips] by using the space occupied by things that aren't in the IIe—like annunciators, the particular I/O mapping, and such. By grounding a pin when you assembled the die, you changed the complexion of the chip.

BYTE: *Are you talking about the IOU [the Input/Output Unit Apple IIe custom chip] in particular?*
Quinn: And the MMU [the Memory-Management Unit custom chip]. The reason I tell this story is to show you how we had a head start on the IIc right from the beginning. I then went to marketing and said, "The chip count is minimal on the IIe. We do it this way. You let us slap out the IIe in six months or so. Then we'll turn around and divert all our energy to this more focused built-in product." And they bought it. So we finally finished up on the IIe.

BYTE: *What kinds of hardware and software compatibility problems did you have? After all, you wanted to keep the Apple IIe compatible with the II+.*
Quinn: As for firmware, I had to struggle like hell to get anybody because everybody was working on the Apple III at that time. I was able to finagle Rick Auricchio. He was one of the original Apple fanatics and hackers—he knew the history. You cannot get someone to write firmware for this machine unless he's been around for three or four years. You have to know how to weave through the mine field [of unofficial but commonly used entry points]. He was extremely good. He added in all the 80-column and Escape-key stuff, and I thought it was really clever. That was a struggle—firmware was right down to the wire on this.

BYTE: *What was the hardest hardware compatibility problem?*
Quinn: We had trouble getting the slots working, particularly with the Microsoft [Z80] card because the timing in this machine was slightly different. The guy who designed the Z80 card, although I liked him, did a schlock job of it, so we had to tune the machine [the IIe] slightly off such that it would be like the Apple II and the card would work.

BYTE: *When did you start working on the IIc?*
Quinn: Strictly speaking, work on the custom-chip design started around 1981. Then, we diverted all our energy to bringing the IIe out, which was obviously successful. A month before the IIe was introduced [in January 1983], my engineering team was winding down.

So, right after Christmas [1982], we started the Apple IIc project. Although we had already done a great deal of the circuit design, the IIc was much more massive a project. Basically, what Steve asked was to build an Apple IIe with an 80-column card, another 64K of memory, two serial cards, a disk controller card, and a mouse card—all that to go in an 11- by 12-inch package.

The goal was for it to fit inside the standard size briefcase you buy at Sears. The things we worried about were heat, how to get the power supply in that small an area, and just how to get all that circuitry in that amount of area. I brought my handy-dandy take-apart IIc. [Peter pops open the Apple IIc; inside are a keyboard module, a disk drive, a power-supply module, and one circuit board with connectors on its rear edge.]

BYTE: *What does the power-supply box on the floor supply to the main unit?*
Quinn: The box just takes AC current and puts out semiregulated 15 volts DC. What this means is that the computer takes an input here [he points to the power-supply connector on the IIc], either from the power-supply box or from any 9- to 20-volt source. We made the range so wide because—well, you know what a car battery does in the winter in Canada. It [the power-supply circuitry internal to the IIc unit] takes any voltage in that range, does a DC-to-DC conversion, and puts out +12, −12, and +5 volts—I think we generate −5 [elsewhere] on the board because we don't use much of it.

The keyboard, we reengineered: it's our own switch. It's a low-cost but extremely reliable switch technology: a thin metal sheet with a spiral cut in it on the top and a contact at the bottom—when you push it in, it spirals in and makes contact with the bottom. We also added another spring that gives the keys a tactile feel. . . .

We've got the 65C02 [microprocessor] in there, which gives us 27 additional op codes. This allowed us to crunch the [additional] firmware into 16K, which is all we had available. Not only did we have to handle the monitor, the 80-column firmware, Applesoft, and all the IIe stuff, we had to handle the two serial ports, the mouse, and all that other good stuff.

BYTE: *The firmware on the Apple IIe mouse interface card takes up 2K of code. You must*
(continued)

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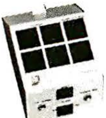
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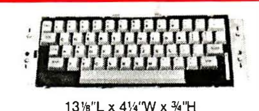
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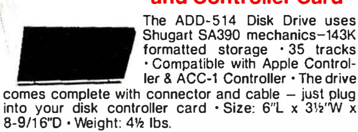
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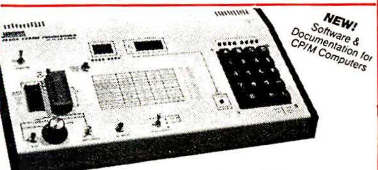
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EPROM Programmer w/JE665 Option
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JE664 EPROM Jumper Mod. No.	EPROM	Programming Voltage	EPROM MANUFACTURER	PRICE
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JM16A	2716, TMS2516 (TI)	25V	Intel, Motorola, Nat., NEC, TI, AMD, Hitachi, Mostek	$14.95
JM16B	TMS2716 (3-V's)	-5V, +5V, +12V	Motorola, TI	$14.95
JM32A	TMS2532	25V	Motorola, TI, Hitachi, OKI	$14.95
JM32B	2732	25V	AMD, Fujitsu, NEC, Hitachi, Intel, Mitsubishi, National	$14.95
JM32C	2732A	21V	Fujitsu, Intel	$14.95
JM64A	MCM68764, MCM68L764	21V	Motorola	$14.95
JM64B	2764	21V	Intel, Fairchild, OKI	$14.95
JM64C	TMS2564	25V	TI	$14.95

Circle 681 on inquiry card.

The two major challenges were heat and radiation.

have done a lot of crunching to get mouse-related code into the space you had in the IIc.
Quinn: Well, we had something they didn't—the custom ICs have built-in handling of the mouse. The Apple II with peripheral cards has to have a certain protocol just to go through the I/O space—this we can map direct [which also decreases the amount of code needed]. We could play a lot of tricks that way.

We made the IIc internationally configurable. This chip here [indicating the model] contains the keyboard map, which, for the international market, will give you French and German and dynamically change the layout. In the international version of the IIc, this switch [just above the "3" key] switches you from, say, a UK to a German layout. An interesting story—we had this switch on the international version and the hole in the case. Rather than tooling up two cases [an additional case without the hole for the American version], we thought about putting in a Dvorak layout for the IIc (the IIe already has it inside, but you have to change the circuit board to get it). At first, marketing wasn't very receptive, but they did some research and it is gaining ground. So, at no extra cost whatsoever, we had Dvorak for the American market.

These two chips, the ACIAs [asynchronous communications interface adapters], handle the two serial ports. We were able to crunch the circuitry down not only with a lot of [custom] integration but also with PALs [programmable array logic chips]. Right now, these are PALs, which are expensive; eventually they will be customs—the GLU is an up-and-coming custom gate array that you place here, which allows you to take these two 74LS161s out and save some cost. [Because of the miscellaneous functions it performs, GLU stands for "glue."] Eventually, you can pass that along to the user—that's what we did with the IIe.

Another way we got space out was to go to hybrids [clusters of resistors, transistors, and other components housed in one IC-like package]. For example, here we took a collection of discrete circuitry—in this case, the video circuitry—and crunched it into one of these. Again, with the audio, we went to the hybrid.

We'll also have a custom TMG [timing] chip here. And we have a third custom that we did in collaboration with the Macintosh group, the IWM [integrated Woz machine], which integrates the full state machine of the disk-controller card.

BYTE: *What were the biggest problems you faced in getting a board this compact to work?*
Quinn: The two major challenges were heat and radiation. There is a lot packed into this area, and we at Apple have to adhere to the corporate spec of having all equipment work up to 40°C ambient. We originally had a lot of CMOS in the computer. We experimented with lower power disk drives that would have been a lot more expensive—we tried all sorts of things. The solution we finally ended up with was to go to some very intricate venting schemes. If you look at the board, it looks like a hunk of Swiss cheese. See all the holes we have for no apparent reason? That's so we get the proper convection when it's laid in [assembled]. We get convection in the disk drive, which is, of course, the biggest offender, and it's vented in very specific ways.

It was funny, the way we decided on where the holes should be. We got out the old Black and Decker, drilled holes and tested it in the oven, taped some holes up and drilled some more—empirical. But we kept on using the low-power drive because we were still over the spec. Finally we did some control experiments and used the normal high-power drive, and that got us under the limit!

BYTE: *It generated less heat than the low-power drives?*
Quinn: The overall unit generated less heat. I took four years of physics, but it's somewhat confusing to me why a higher power drive would cause less heat. Our only explanation is that it caused enough heat such that you got a heat rise, which pulled in a vacuum—and that got us the convection we needed.

BYTE: *How did you manage to meet the RFI (radio frequency interference) specifications?*
Quinn: We were really careful. On the top, we power-gridded the power lines very carefully and created a virtual ground plane. We were very careful with the layout of the components—for example, the oscillator, which generates 14 MHz. The higher in frequency you get, the scarier it gets, so we only ran 14 MHz to chips that were right in this immediate area.

On the bottom, where the noisier power signals are, we took this metal sheet, which is tied at about 12 points via screws so we keep the whole grounded. Unfortunately, EMI [electromagnetic interference] is something of a black art. We went through many revisions of the board until we finally got it. I'm pretty proud of that. [Peter reassembles the IIc, which takes less than 15 seconds.]

BYTE: *How does the keyboard connect to the main unit?*
Quinn: Flat cable.

BYTE: *So with the exception of some cables that you didn't put in, you're actually assembling a unit.*
Quinn: That's correct. Except for the two cables and the screws, that's it—that's my second born.

BYTE: *You once said the IIc was called a very low-cost machine.*
Quinn: The Apple IIe's first code name was LCA, for "low-cost Apple." Then this [the IIc], because everything was going to be built-in and crunched, was "very low-cost."

BYTE: *But the price really ended up not being that low.*
Quinn: Well, VLC at the time did not include a disk drive (which is a big cost factor), it was only 64K, it didn't have all the I/O the IIc has. It originally had one serial port, but marketing came back and said, "Uh-uh, everyone's going to want a modem, ultimately, in the home and in industry. Everyone is going to want a printer—and, specifically, they're not going to want to unplug one to get the other." That's how we came

(continued on page A120)

PART III

THE MACINTOSH AND THE LISA 2, THE FUTURE OF APPLE

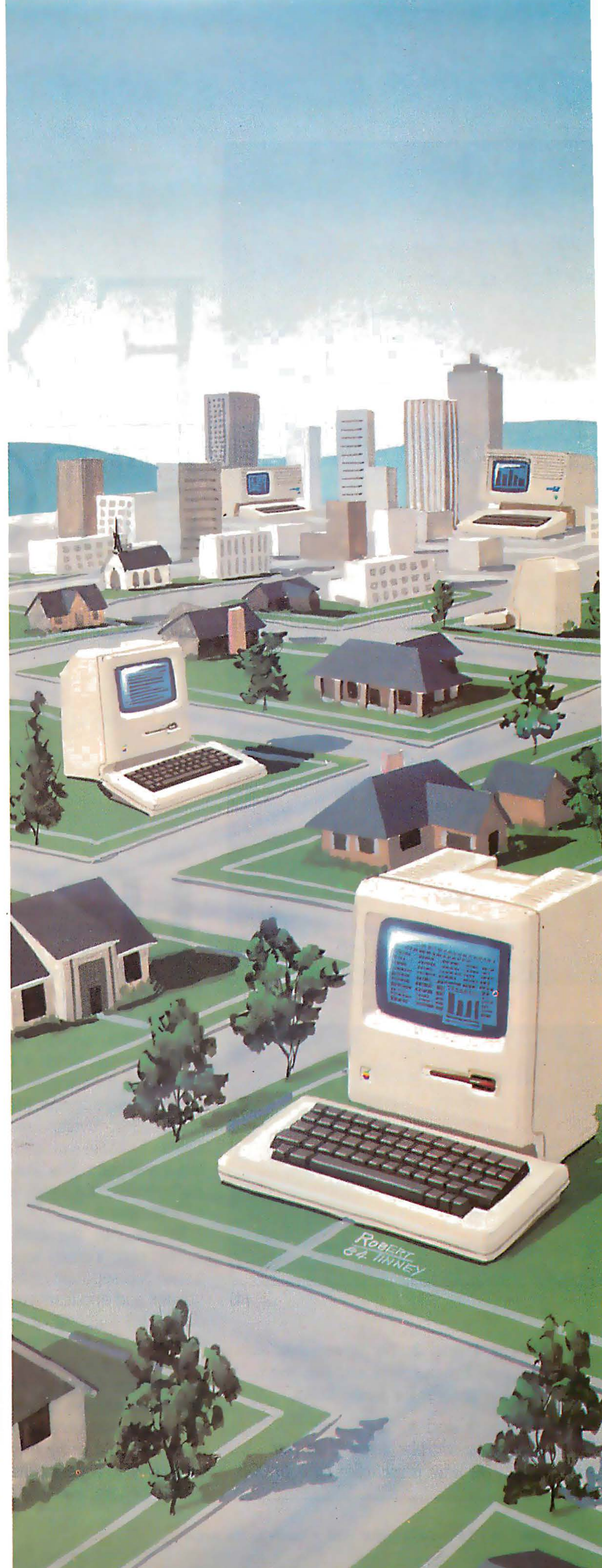


ILLUSTRATION BY ROBERT TINNEY

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(2)



(3)



(4)

Photos 1 and 2: *The 10-megabyte disk drive from Davong, front and rear panel. The drive is controlled by an 8088.*

Photos 3 and 4: *The Tecmar 5-megabyte cartridge disk and its rear panel. The drive is controlled by a 68008.*

BY DAVID W. SMITH

EXTRA STORAGE FOR THE MAC

Tecmar and Davong face-off with two hard-disk entries

Up until now, Apple's Macintosh computer was devoid of hardware add-ons. Tecmar's 5-megabyte cartridge-disk drive and Davong's 10-megabyte fixed-disk drive have changed that.

From the first, Mac has been in need of some disk memory expansion. A standard Mac disk holds 400K bytes. Mac's operating system files that are needed to boot and support Mac's overlays require 230K bytes, leaving only 170K bytes of usable storage for both applications and data. MacWrite and MacPaint each require 60K bytes, leaving only 50K of free space.

To alleviate the congestion on the system disk, a crafty soul might propose to use two separate disks, one for system utilities and applications and another for data. This juggling of applications and data appears to solve the space problem, but you soon find a greater problem: floppy flogging. Anyone who has used a machine with a single-disk drive can attest that very large databases (or large overlaid programs) require swapping disks to access certain data needed by the program at any given time. This is an old problem, and Apple hasn't solved it.

THE BETTER WAY

Tecmar's half-height 5-megabyte cartridge hard disk, the MacDrive, and Davong's 10-megabyte MacDisk hard disk both feature microprocessor control. (I have only recently received Tecmar's 10-megabyte hard disk.) These "intelligent" controlled drives are rare in the microcomputer market and may be a prelude to local-area network expansion for the Mac in the future. To that end, Tecmar has the advantage. It's a 68008-controlled drive, whereas Davong's MacDisk is controlled by an 8088. The Tecmar 68008 is consistent with the Mac's central processor, and, should expansion to a network be possible in the future, the Tecmar drive will be able to download and run code from one or more hosts. The Davong will require a motherboard swap.

(continued)

David W. Smith is a freelance writer. He can be reached at 1602 Dove Haven, Pflugerville, TX 78660.

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AT A GLANCE

Name
MacDisk

Type
10-megabyte Winchester hard-disk system

Manufacturer
Davong Systems Inc.
217 Humbolt Court
Sunnyvale, CA 94089
(408) 734-4900

Computer Needed
Apple Macintosh

Software required
None; Special System version supplied

Features
8088-processor-controlled drive; 4⅜ by 12 by 14 inches

Options
Winchester hard disk, sizes 10, 15, 21, 32, and 40 megabytes

Price
$2395 (10-megabyte)

Documentation
MacDisk Owners Manual

Name
MacDrive

Type
5-megabyte cartridge removable hard-disk system (10-megabyte Winchester hard-disk system soon to be available) 5/5 combination, 5/10 combination

Manufacturer
Tecmar Inc.
Personal Products Division
6225 Cochran Road
Solon, Ohio 44139-3377
(216) 349-0600

Computer Needed
Apple Macintosh

Software required
None; Special System version supplied

Features
68008-processor controller; 5¾ by 10⅜ by 10⅝ inches

Options
5-megabyte half-height cartridge, 10-megabyte half-height fixed Winchester, 5 cartridge/10 fixed combo, and 5/5 dual cartridge

Price
$1396 (5-megabyte cartridge)

Documentation
MacDrive Users Guide

The Tecmar unit has two slots for its half-height drive components, and beneath that is the controller card. Under the controller card is the processor card, which includes a 68008 microprocessor, room for 128K by es (up to 512K with 256K bytes of RAM) and two 28-pin ROM/EPROM sockets that support 2/4/8/16K-byte EPROMs (erasable programmable read-only memories). The Davong 8088 disk has its full-height drive mounted on the right side, a control panel on the left front, and a combination processor/controller card mounted on top. In addition, the board includes room for two 4816 4K by 8K RAMs and an EPROM (of up to 16K bytes). Both attach directly to the Mac through its TS-422 serial synchronous data link.

OTHER FEATURES

The insides of both well-constructed units are very clean. The cases of both are the same color and texture as the Mac. Both manufacturers mention placing the Mac on top of their units, and in most cases, this would be an improvement in the screen viewing angle.

The Davong is a bit wider and shorter than the Tecmar unit. The front panels of the units are strikingly different. The Davong MacDisk has a more colorful front-panel insert, with translucent display areas where four operational messages are backlit by LEDs (light-emitting diodes). Tecmar is almost sedate in its front-panel approach. A simple one-color tag marks the unit with name and maker. In the place where a standard floppy-disk drive would have a head-load light, the Tecmar has a "hear -beat" LED. This light displays different bright and dim pulses as different tasks are being carried out: a shor pulse for a write or read, long stretches for communications, and a very dim pulse during the processor's operation. If the processor stops, so does the LED.

The back panel of Tecmar's MacDrive includes a switched 110-volt AC outlet right on the back of the unit. The manual explains that you plug the Mac into the drive and then turn the Macintosh on and off from the drive. The Tecmar box also includes a spare DB-9 connector wired in parallel with the first port. This extra connector makes AppleBus upgrading just a little simpler in that no extra connectors are needed and no Y-

Tecmar greets its customers with a very simple and explanatory users guide. Unfortunately, I cannot say the same for Davong.

cables will be necessary when multihosts start using the MacDrive.

The Davong doesn't include the little extras that Tecmar does.

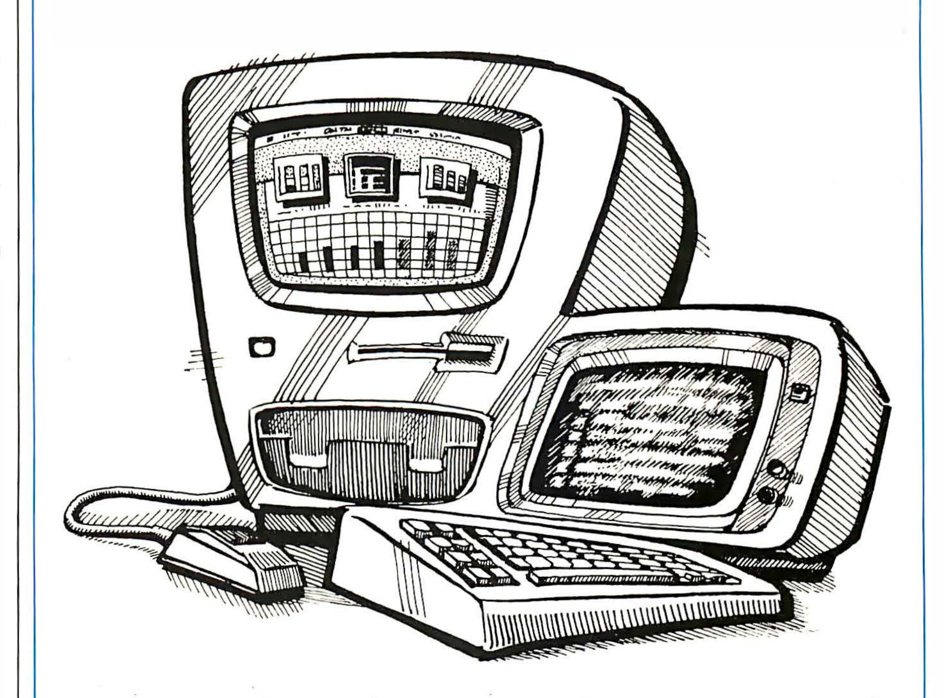
DOCUMENTATION

Tecmar greets its customers with a very simple and explanatory users guide. The manual shows in great detail how and where to plug in the MacDrive. It shows every possible way to describe each action and every possible thing that can go wrong. It is written exceptionally well. Mention of "volumes" or "remapped sectors" or "read/write display LED" just doesn't fit in the Macintosh's market. Macintosh is the "computer for the rest of us," remember. However, the manual for MacDisk is complete and, except for the technical jargon, is readable.

The software for both drives works simply and well. Both makers provide an installed System file on a "boot" disk. In addition, Davong provides a separate disk-diagnostic routine, a disk-initialization routine, and an install routine. Why the company provides the install routine is unknown since the System file should never change. Only new versions of Finder, the locator and resource manager of Mac, should ever be updated. As for the initialization and diagnostics, they are in the Tecmar software too, and they are transparent. When a blank disk is inserted (in the case of the cartridge) or a new disk is delivered, the system automatically initializes. Same with diagnostics, except that Tecmar's report on the fly, rather than doing a special check as you request it. (Who needs to know the

(continued)

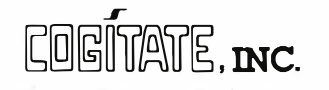
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DEALER INQUIRIES INVITED

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"number of sectors remapped" in a computer like the Mac?)

Tecmar's cartridge drive, as you might imagine, couldn't keep up with Davong's sealed Winchester. A modified disk write/read program, run in Microsoft BASIC, loaded 16,384 records of 64 characters (each taking 2 bytes) for a total of 2,097,152 bytes. For me to include comparison data generated from BASIC didn't seem fair, since I'd only be comparing the transfer rates. I did a direct copy of 2 megabytes with the DUPLICATE command in the file pull-down menu. This will do a machine-language speed direct copy of anything. The results are interesting and are shown in table 1.

Just to give you an idea of the speed of the drives with respect to the built-in 5¼-inch disk, I copied the BYTE standard-length data file with DUPLICATE. First I did a file-to-file on the 5¼-inch disk, and then on the Davong and Tecmar drives. The 5¼-inch disk took 22 seconds to do the standard BASIC write and 22 seconds to read the 65,536 bytes of data. The Davong MacDisk took just 10 seconds to write and 6 seconds to read. The 5-megabyte-cartridge Tecmar MacDrive swung in pretty close with 13 seconds to write and 7 seconds to read. Keep in mind that the larger the data file size, the less time wasted.

Some other considerations: the MacDisk was noticeably louder than the Tecmar equivalent. The cooling fan is to blame; Tecmar chose a quieter and more expensive fan. There is a problem with the rubber feet Tecmar uses: they are glued on and came off almost immediately.

Table 1: *Time required to copy 2 megabytes from file to file.*

Unit	Duplicate time
Davong MacDisk 10-megabyte hard-disk	2:37
Tecmar MacDrive 5-megabyte cartridge	4:12
Tecmar MacDrive 10-megabyte hard-disk	3:04

SUMMARY

I would have to say that Tecmar won this one—hands down. But it is difficult to give Davong a second place. It's like saying that a Ferrari is better or worse than a Lamborghini. Both machines do their job excellently and with relative transparency to the Macintosh. But anyone who recognizes the limitations of the present Macintosh or requires more support in the future for Macintosh/Lisa local networks should take a look at the Tecmar system. ■

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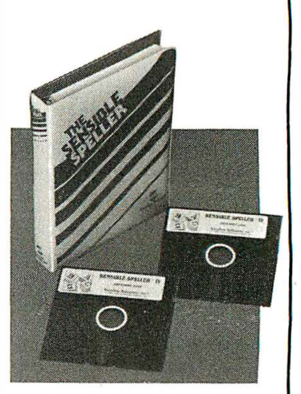
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BY MITCH TRACHTENBERG

MULTIPLAN/CHART ON THE MACINTOSH

This best-selling spreadsheet and its graphic complement take full advantage of Mac's high-intensity graphics and innovative user interface

By any standard of measure, Multiplan for the Macintosh is a winner. Not only has Microsoft managed to retain the Multiplan features that legions of spreadsheet users find so desirable, it has also managed to fully exploit Macintosh's unique graphics and user interface. By doing so, the company has created a product that rivals, and in many ways exceeds, anything else available in the spreadsheet genre, especially when combined with a companion graphics generator program called Chart (see "Chart, Multiplan's Graphics Companion" on page A90).

Not all the news is good, however. The Macintosh version of Multiplan exhibits a few idiosyncrasies, as well as some command incompatibilities with previous versions. In addition, users familiar with integrated packages may find swapping data between this spreadsheet and its graphics companion arduous.

THE PACKAGE

Multiplan is supplied on a single 3½-inch Sony floppy disk containing the Macintosh operating system, the Multiplan program, and a Help file. Included with the disk is a surprisingly thin, 172-page instruction manual (compared with more than 400 pages in the Apple II Multiplan manual). An order form for a $10 backup disk is also provided.

Multiplan, like its companion program Chart, is copy-protected. Microsoft expects the purchaser to make a working copy of the programs for regular use. However, the master disk must be inserted into the Macintosh every time the computer is restarted. As a result, the possibility of disk damage due to normal wear and tear exists.

THE SCREEN

When you first load Multiplan, the screen shown in figure 1 is presented. This screen display is a joy to behold for those who have wrestled with pre-Macintosh spreadsheet displays. Entries appear as black characters on a white background, cells are bounded by dotted lines, row and column numbers are clear, and the "current cell" is clearly identified in reverse video surrounded by a thin boundary.

The menu bar and main window will be familiar to Macintosh veterans since Multiplan's main window makes use of common Macintosh symbols. Scroll bars and arrows, title bar, sizing box, and window bars operate in usual Mac fashion. In addition, there is a formula bar between the menu bar and the main window, which shows the address and contents of the current cell. In the empty spreadsheet of figure 1, cell R1C1 (row 1, column 1) is the current cell.

One disappointment is the small size of the worksheet area that Multiplan displays. Unfortunately, worksheet clarity is gained at the expense of display size. At its largest normal setting, the main window displays 15 rows by 6 standard (10-character-wide) columns. This compares with 20 rows by 7 columns for Multiplan on the IBM and 20 rows by 8 (9-character) columns for Lotus 1-2-3. For those who work with wide worksheets, this is not good news.

One quirky aspect of the program results in protected worksheets displaying 16 rows at a time rather than 15 rows. Room for the extra row is apparently gained by eliminating the grid lines used in unprotected worksheets.

GETTING AROUND THE WORKSHEET

The Multiplan mouse pointer takes on different shapes as it moves across the display. These shapes correspond to the effect that a click or drag of the mouse has at various locations. When the mouse pointer is over worksheet cells ready to select a cell, it looks like a shadowed plus sign. When over the title bar, ready to move the worksheet window, it appears as a four directional arrow. Other shapes and actions are similarly logical in nature.

I am distressed by the absence of one

(continued)

Mitch Trachtenberg (29 Inman St., Cambridge, MA 02139) edits the Macintosh newsletter for the Boston Computer Society. He is a freelance instructor, training small groups in the use of business software.

pictorial cue. To expand a formula, Multiplan accepts a click of the mouse in any worksheet cell as an instruction to enter that cell's address into the current cell's formula. At other times, a click of the mouse in a worksheet cell completes any entry in progress and selects the clicked cell. In my opinion, the program would be much easier to use if the pointer changed to indicate these different modes. Borrowing from MacPaint, I would propose using a lasso to indicate when a click of the mouse grabs a worksheet cell and places it in another cell's formula. The pointer for the other mode could simply be a bull's eye.

Getting around the worksheet is fairly simple, despite the fact that Microsoft has inexplicably eliminated the GOTO command. Clicking any cell makes it the current cell. Movement to adjacent cells is accomplished by pressing Return in order to descend, Shifted Return to ascend, Tab to go right, and Shifted Tab to go left.

Larger movements are accomplished using scroll bars. The scroll system is not a perfect solution to getting around, however. Since the scroll bars represent the entire 63-column by 255-row worksheet, it is hard to estimate exactly where you will land when you drag a scroll box. Second, a typical move requires a horizontal scroll and a second vertical scroll. Because Multiplan doesn't cut off mouse input while the screen is updating, a click in what you thought was the current scroll box location may actually be to one side of the scroll box. If this is the case, Multiplan responds by scrolling again, generally back to where you started. This is a minor but irritating idiosyncrasy.

In addition to the scroll boxes, Multiplan allows you to select (and scroll the display to) any named range. You can also scroll to the active cell, the last cell of the worksheet, or, in a two-step process, the first cell of the worksheet. Still, it is hard to understand why Microsoft eliminated the GOTO {address} command. Such a command would provide compatibility with the GOTO commands available in the old Multiplan, Lotus 1-2-3, and most other spreadsheet programs.

Another disconcerting aspect of Macintosh Multiplan is the possibility, using scroll bars, of ending up in a section of the worksheet that does not contain the current cell. For people trained in other spreadsheets, in which the display is scrolled by changing the current cell's location, this will cause confusion and probably some surprise changes to cells. I found myself entering material into the cell under the pointer, only to notice upon hitting Enter that my pointer was far, far away from the current cell. After a bit of use, this problem resolves itself if you adjust to the idea that you can move the display without changing the current cell.

DATA ENTRY

Hands down, the silliest feature of previous versions of Multiplan was the ill-conceived Command menu. Instead of requesting a command by typing a slash or control character, Multiplan insisted on starting every entry with a command, except when the previous action was an entry completed with an arrow key.

Now, these machinations are unnecessary. To enter a label, you simply type the label and hit Enter, Return, or Tab. To enter a number, type the number and hit Enter, Return, or Tab. To enter a formula that might be confused with a label, precede it with an equals sign, type the formula, and hit Enter, Return, or Tab. This is an enormous improvement over preceding Multiplan procedures.

SPREADSHEET OPTIONS

Macintosh Multiplan exhibits the standard range of spreadsheet functions and then some. It has lookup and index functions to enable one part of a spreadsheet to selectively choose data from another. Two functions—itercnt and delta—give the user control over the iteration feature used to keep recalculating circular references until they converge satisfactorily. Logical functions, such as IF, AND, NOT, OR, ISERROR, and ISNA, together with Multiplan's text string handling, allow the program to give results in English. Multiplan does, however, lack date functions like those in Lotus 1-2-3. Chart makes several additional functions available via its ANALYZE command. These functions, which generate results such as cumulative sums, trend lines, and so on, are a nice supplement to Multiplan's own.

(continued)

Figure 1: *Multiplan's screen format is a hybrid of Macintosh and Microsoft conventions. The selected cell is highlighted in reverse video, and the shadowed plus sign signifies the cursor. The cleanliness of the overall grid is a definite plus but is offset by the limited size of the spreadsheet window—15 rows by 6 columns.*

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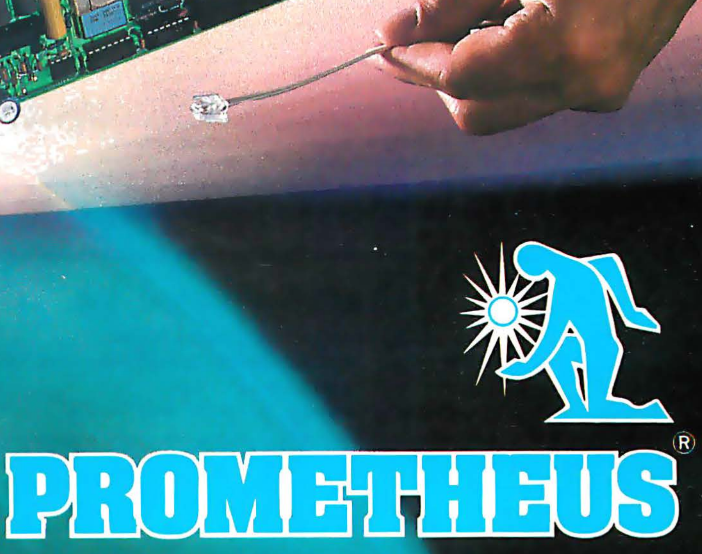
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To enter a reference to a worksheet cell or range into a Multiplan formula, you click the cell or drag the range. The cell or range is indicated as you press the mouse button by a slight change in the region's boundary appearance—the dotted lines become finer. The range being indicated appears and is updated instantly in the formula bar for the cell being entered. Cells can also be entered into formulas by typing their addresses. All cell references generated by clicking or dragging a range are initially relative: that is, they identify a location based on its distance from the current cell.

The appearance of a Multiplan relative reference is unchanged from previous versions of the program. Thus R|+x|C|$-y$| refers to a cell x rows down and y columns back. References can be converted from relative to absolute or vice versa with the ABSOLUTE/RELATIVE REFERENCE command on the Edit pull-down menu (or with the ^T key command). This command is a toggle type, and, in a nifty bit of programming, the name of the command that appears in the pull-down menu switches from ABSOLUTE REFERENCE to RELATIVE REFERENCE depending on the status of the command. As in other Macintosh applications, commands that cannot be used at a given moment are shown dimmed.

Adding or changing formulas is exceptionally easy with PASTE FUNCTION. Select PASTE FUNCTION and Multiplan responds with a list of available operations. Any operation can be inserted into your formula. Multiplan adds a leading equals sign if appropriate and supplies the parentheses used to bound arguments. The program will also locate your insertion point in between the parentheses.

PASTE NAME works in exactly the same way. PASTE NAME allows you to choose the appropriate named range from a list of all the ranges you have defined. Together, these two commands make Multiplan formulas extremely easy to develop.

Editing entries is also easy. Moving the mouse pointer to the menu bar causes the pointer shape to change to an I-beam. When the pointer assumes this form, editing is done exactly as in MacWrite.

If, despite all of Multiplan's helpful features, you do make a mistake, you can simply undo it by selecting UNDO from the Edit pull-down menu (or typing ^Z at the keyboard). As in other Macintosh software, the UNDO command restores the worksheet to its previous state. As things stand now, there is one level of UNDO; mistakes become permanent if you don't catch them before making an additional change to the worksheet. The UNDO command itself can be undone by selecting UNDO a second time. As with the ABSOLUTE/RELATIVE REFERENCE toggle mentioned above, UNDO changes to REDO in the pull-down menu when UNDO has been chosen

(continued)

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once. Thus even the menus in this program provide current information.

Multiplan can be set to recalculate automatically after each entry, or to recalculate only when requested to do so. What's different in Multiplan from other spreadsheets is the ability to suspend recalculation in order to respond to keyboard or mouse commands. Even when recalculation is lengthy, there is no need to stop work while number crunching proceeds.

Multiplan has always excelled in the ease with which formulas or data can be copied from place to place. To copy the contents of one cell to subsequent cells, you simply drag the mouse over the original cell and the copy-to range and choose the FILL RIGHT command from the Edit menu. An identical process is used to FILL DOWN. FILL RIGHT and FILL DOWN, like most commonly used commands, can also be selected from the keyboard by ^R and

Chart, Multiplan's Graphics Companion

Two things can be said about Chart at the outset. First, it is an extraordinary tool for the creation of presentation graphics. It provides a wide variety of formats, allows customization of graphs in almost every imaginable respect, and has enough automatic features to be learned quite rapidly.

Second, until the Macintosh is able to run applications concurrently, Chart cannot really be used with Multiplan to generate instant what-if-type graphs.

The version of Chart I've been using is a prerelease copy, and thus subject to change. Nonetheless, Chart's documentation was final when this article was prepared, so there should be few, if any, major surprises.

Chart will look familiar to anyone who has used Macintosh Multiplan. It has the same File, Edit, and Format pull-down menu names as Multiplan, along with some new ones: Data, Gallery, and Chart. The initial display presents two windows: a small one in the foreground, labeled New Series, and a large window in the background, labeled Untitled. Data is entered into Series windows, and the resulting Chart is drawn in the larger window.

To give you an idea of how easy it is to use Chart, let's walk through the steps involved in plotting a four-number sequence. We will completely ignore the bells and whistles Chart offers, as well as the program's manual. Results of the steps are illustrated by figures 1, 2, and 3.

The numbers we'll use are the total quarterly sales from a Multiplan printout: 310, 530, 295, and 800. Regardless of where the pointer is on the display, the moment you type the first digit a new window appears, labeled "Series HH:MM:SS XM." The time is filled in with the actual Macintosh clock time. This window, aside from the title, is a copy of the New Series window. It is divided into two columns, labeled X and Y, which accept "Categories" and "Values" (Chart's terminology). A Plot Series "button" appears above the two columns, and there is a blacked-out box labeled "Order." The number you type appears in the Y column, and the X column is automatically given the sequential value 1.

As you continue entering the values, separating them by presses of the Return or Enter key, Chart provides sequential numbers in the X column. Mistakes can be edited as in MacWrite or Multiplan; the pointer becomes an insertion point, assumes the shape of an I-beam, and can be located by clicking the mouse. Dragging will select material, which can then be deleted, cut, or copied.

Once you have made the four entries, you click the Plot Series box. In a few seconds, the large window is filled with a bar chart. A click in this large window moves it to the foreground. Figure 1 illustrates Chart's data-entry screen.

The first nonintuitive step comes when you want something other than a bar chart. When this is the case, you pull down the Gallery menu and choose the type of Chart you are interested in. Let's choose a pie chart. Chart presents a "Gallery" window (see figure 2), showing 6 styles of pie charts. Clicking any one of the Charts shown selects it, and clicking OK causes Chart to replot the data.

Customizing the Chart

Pulling down the Chart menu shows an option labeled "Add Legend." When you choose this option, the chart is replotted to make room for a legend, which

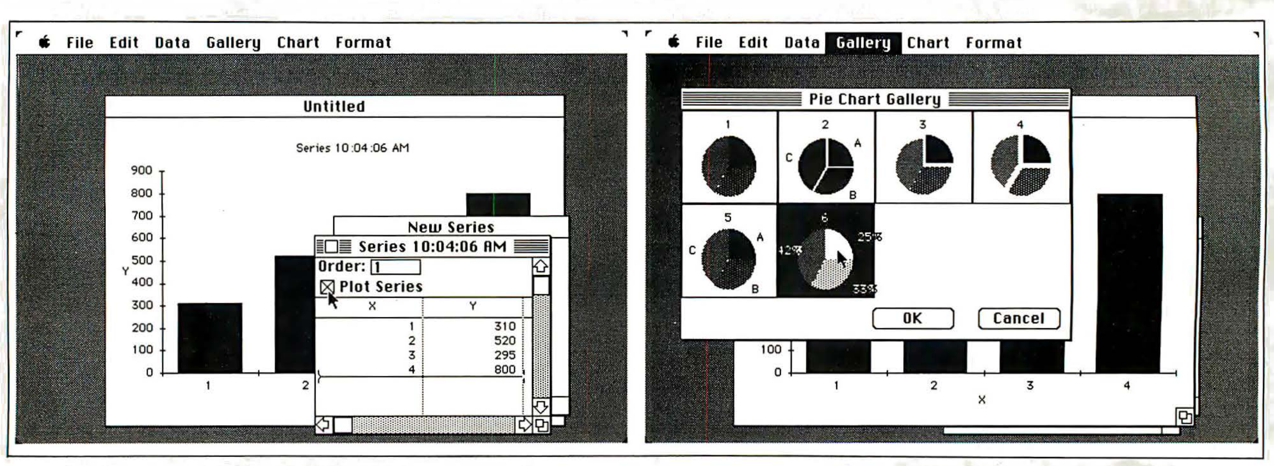


Figure 1: *Chart's data-entry screen provides users with two windows on graphics activity.*

Figure 2: *Chart offers several styles of pie charts.*

^D, respectively. Entire cells or blocks of cells can be cut or copied from the worksheet into the Macintosh Clipboard. From here they can be pasted into other sections of the worksheet, into other worksheets, or even into other application programs such as Chart.

Multiplan includes a single-key sort, which acts only on full rows, sorting the rows based on the contents of the selected column. Sorts can be in ascending or descending order. This limited sorting ability represents the extent of Multiplan's database functions.

Macintosh Multiplan has extensive formatting control over the worksheet. Selected cells or regions can be formatted to display data as integers, dollars, percentages, or in scientific notation. The number of decimal places displayed is also optional. The whole worksheet can even alternate between

(continued)

matches patterns or markers on the chart with the entries in the Y column of the series window. This is not particularly helpful in a series like my sample, in which I have simply let Chart fill in the Y column with sequencing numbers. But Chart allows you to create series windows in which the Y column is filled with text or sequential dates, making a legend very helpful.

Chart offers numerous options. Text can be boldfaced, italicized, or both. Text can be made small, medium, or large. You can change border widths, as well as the style of borders (from rectangular to beveled, double, round, or shadowed). You can select background patterns for different regions. Changes made to a chart in one format are preserved to the extent possible when additional formats are chosen. Figure 3 illustrates some of the display features available in Chart.

Users are given similar control over the display of data in the Series windows, which governs the presentation of the data on the axes of the chart. Category and Value entry columns can be independently formatted to display numbers as integers, fixed numbers with a set number of decimal places, percentages, dollars, and so on. Custom formats can also be designed by adding text before and/or after the value.

When a Series window is active, you can set the redrawing of the chart to manual, but when changes are made to the chart itself, every change causes a complete redrawing. On my version, redrawing took between 5 and 10 seconds: too long for comfort. Because much of the work of varying placement, type style, etc. is going to be trial and error, these delays add up to considerable wasted time.

ADDING SERIES

According to the manual, Chart can plot several series up to a total of about 100 data points. You enlarge series by either typing into the New Series window or choosing a series type from the Data menu. This is also the method used to change the Series Name, Category Name, and Value Name, which become the chart's title, x-axis label, and y-axis label, respectively. Depending on the type of series chosen, Chart will assist you by filling in the Categories column automatically. For a date series, for example, you can instruct Chart to start with 1/1/82 and increase each entry by three months.

Not all open data series need to be plotted at a given time. Using the LIST command from the Data pull-down menu, you can select which series you want listed and which series you want plotted. In addition, the order in which series are plotted can be varied by changing the number in the "Order" box of the series you wish to change. This is important because the first series plotted is the source of the chart title and axis labels.

Whenever a series window is in the foreground, Chart offers an Analysis feature from the Data pull-down menu. This consists of several operations on data series—Average, Trend, Growth, Cumulative Sum, Difference, and Percent—each of which generates a new series, which is labeled with the name of the analyzed series and the type of analysis that has been performed. The analysis series can be plotted like any other data series. A statistical feature generates additional, unplottable information (number of points, median, standard deviation, correlation coefficient, etc.).

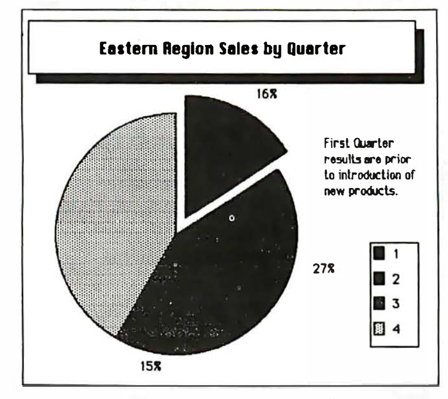


Figure 3: *Graphs generated can be adorned with a variety of textures for appealing appearances.*

AT A GLANCE

Name
Chart

Type
Graphics program

Manufacturer
Microsoft Corporation
10700 Northrup Way
Bellevue, WA 98004
(206) 828-8080

Computer Needed
Apple Macintosh or Lisa running MacWorks

Price
$125

Documentation
184-page manual

Audience
Anyone desiring high-quality graphics from numerical information

SORTING AND PASTING

Chart has a Sort option that allows you to enter items in random order and sort them in ascending or descending order. This can be useful when entering unalphabetized information and then charting it in alphabetical order.

Chart will import from Multiplan worksheets or from any text file. In a text file, items must be separated by commas or tabs, and each line must end with a Return. Every line will be treated like a Multiplan row. When importing data, Chart chooses the longest dimension of the region to be imported and uses this to divide the information into series. In other words, if there are more columns than rows (the rows are "longer") in a region being imported, each row is treated as a series. If there are more rows than columns (the columns are "longer"), each column is treated as a series.

The transfer of data is accomplished via

(continued)

AT A GLANCE

Name
Microsoft Multiplan for Apple Macintosh

Type
Electronic worksheet program

Manufacturer
Microsoft Corporation
10700 Northup Way
Bellevue, WA 98004
(206) 828-8080

Format
3½-inch floppy disk (Macintosh format disk)

Computer
Apple Macintosh or Apple Lisa running MacWorks

Documentation
Three-part, 172-page manual, including "Learning Multiplan," "Using Multiplan," and "Multiplan Reference"

Price
$195 (backup disk costs an additional $10)

Audience
Anyone doing spreadsheet-type calculations

displaying numbers with or without commas inserted.

All entries, including values, can be formatted to display with left, right, or centered orientation in their cells. Oversize entries, when centered, spill into adjacent cells. This makes centering section titles a simple matter. Because labels always overflow into adjacent cells as long as the adjacent cells are empty, there is no need to format cells with the CONTINUOUS command, as in previous Multiplans. Alignment commands are also available from the keyboard through using the three adjacent and appropriately ordered keys ^F, ^G, and ^H.

Multiplan's useful Show Formulas option is unchanged from previous versions of the program.

Multiplan worksheets can be saved in either Normal or SYLK (symbolic link) format. SYLK files are ASCII (American Standard Code for Information Interchange) encoded for telecommunicating worksheets to and from other computers. However, saving and loading SYLK files are slow. My benchmark file took about a minute to save and slightly more than a minute to load in SYLK format (table 1). Macintosh Multiplan cannot directly import worksheet files from non-Multiplan spreadsheets, such as VisiCalc or Lotus 1-2-3.

PRINTING

Macintosh Multiplan excels at printing. Page breaks are determined based on the information provided in the Page Setup dialogue box (figure 2) and are visible on the screen as dashed lines. Choosing SET PAGE BREAK from the Options pull-down menu inserts a page break above and to the left of the selected range. User-set page breaks, which can be deleted, appear with longer dashes than the automatic page breaks, which cannot. This is yet another example of the exceptional use Multiplan makes of the Macintosh high-resolution display.

Multiplan can print sideways, simplifying the printout and assembly of wide spreadsheets. Unfortunately, it cannot print out a continuous sideways form.

The printing process involves the creation of a Print file. Because this takes up disk space, you may run into problems trying to print with a nearly full disk. When this is the case, you are

(continued)

the Clipboard. The region of the Multiplan worksheet that you wish to import is copied to the Clipboard, Multiplan is shut down, Chart is loaded, and the data is "pasted" with the command on the Edit menu. Depending on the type of series that is open when the PASTE command is issued, Chart will use imported text as Category labels. Unfortunately, there is no way of importing names for the Series, Categories, or Values; these must be changed manually by using the Data menu's window options.

Charts can be linked to Multiplan worksheets by choosing the PASTE AND LINK command to import data. Once linked to a worksheet, Chart will automatically check the worksheet for the most recent data before plotting. Using this feature really requires two disk drives, although a great deal of disk juggling can accomplish the same end. It is impossible to link to a word-processing document.

SAVING, LOADING, PRINTING

Files are saved with the SAVE or SAVE AS command on the Edit menu. Both the chart format and the data series are saved together. While formats and data are saved together under a common filename, it is possible to load only a saved format or only the saved data series. Loading saved data causes it to be added to the list of series already open, while loading a saved format wipes out the open format. This feature means that once a standard format is painstakingly established, you can easily plug different data series into it. In part, this compensates for the slowness of customizing a chart.

Chart's Page Setup and Print dialogue boxes match those of Multiplan. The printout is scaled to fill the page properly according to the information provided in Page Setup. As a result, the printed resolution often exceeds that of the display window. In my prerelease copy, the geometry of a printed graph sometimes varied from that of a displayed graph. While at first disconcerting, this feature always improved the appearance of the printed chart.

If Print is selected when a series is in the foreground, the printout will consist of the series rather than the plot, a useful method of generating tables.

DOCUMENTATION

Chart's 184-page manual matches Multiplan's in size and format. Since Chart is a harder program to learn than Multiplan, I believe the documentation should include more examples than it does. Nonetheless, this manual, like Multiplan's, does an excellent job of giving a user both a quick tutorial and a fairly comprehensive reference.

Chart has so many options it will take a good deal of time for users to become proficient. Yet it has sufficient automatic choices that a new user can create acceptable graphics within an hour. Microsoft has done a good job of matching Chart and Multiplan; the two programs are similar enough in operation that learning one helps substantially in learning the other.

Chart's analysis features are a pleasant surprise and make the program genuinely useful for stand-alone information analysis. In combination with MacWrite, Chart could be a worthwhile purchase even for those who will not be using Multiplan.

—*Mitch Trachtenberg*

warned to move some documents and prompted to try again.

Printing quality is exceptional in both standard and high-quality modes, but I judge the draft-quality printout on Apple's Imagewriter unacceptable. There are too many circumstances in which columns of numbers do not align properly.

HELP AND DOCUMENTATION

Multiplan's Help facility, entered by choosing ABOUT MULTIPLAN from the menu, is thorough, well written, well organized, and easy to navigate. Unfortunately, it is merely an on-line manual—not a context-sensitive Help facility. Context-sensitive Help is nothing new, and it is surprising that designers who were sophisticated enough to make command names context-sensitive didn't bother to make Help context-sensitive.

On first sight, I thought the written manual supplied with Multiplan looked rather skimpy. After using the manual, I think it is a model of the correct way to compile documentation. In its 172 pages, it includes a quick tutorial ("Learning Multiplan"), a good how-to section ("Using Multiplan"), and a well-organized reference, glossary, and index. This is a manual that explains things quickly and clearly. Three cheers for the Microsoft technical writers.

OTHER FEATURES

An invaluable aspect of Macintosh Multiplan is its ability to link worksheets together. Instead of the bewildering external COPY command of previous Multiplans, Macintosh Multiplan uses a PASTE and LINK command. Cells from a supporting worksheet are copied into the Clipboard, which keeps track of documents' sources. Then, the source worksheet is closed, the worksheet where the information is to go is opened, and cells are pasted and linked into the open worksheet. Multiplan presents an alert box to let you know what you are linking and gives you a chance to cancel as well. Once the link is established, Multiplan shows the source of the linked information—both the document and the cell—in the formula bar when the linked cell is made the current cell.

Multiplan also provides versatility in the use of names. You can assign any range in Multiplan a name of as many as 31 characters. When there is text in the current cell of the selected range, Multiplan proposes this text as the range name. This makes it very easy to name worksheet rows and columns with the labels used as headings.

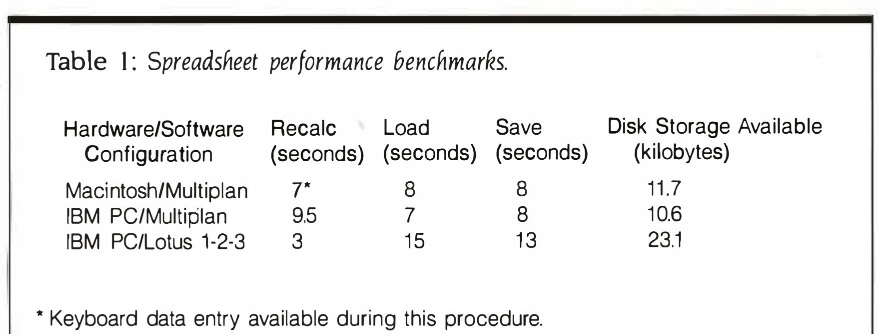
You can also protect information. After removing cell protection from those cells in which data entry is to be permitted, you select PROTECT DOCUMENT from the Options menu. Protected documents are displayed without grid lines or row and column headers, and unprotected cells within them are underlined.

You can create hidden columns by setting the width of any column to zero. Confidential information can be placed in these hidden columns, and, when the worksheet is protected, there is no hint to an inexperienced user that these columns exist. Hidden columns are not printed out.

Macintosh Multiplan can display as many as four windows on one worksheet. Windows are split by dragging the dark "window bars" into the scroll bars.

Multiplan allows you to freeze any number of rows and columns as titles, making it easier to find your way in large worksheets. Titles are indicated on the display by a solid line extending out from the row or column header, thus separating them from the remainder of the worksheet.

Judged on its merits as a spreadsheet, Macintosh Multiplan scores high marks. It has a wide range of functions, and its ease of use is exceptional. The Macintosh version of Multiplan takes advantage of the Mac's high-resolution display, giving substantial amounts of worksheet information via visual cues. Printing, formatting, and file handling are unmatched thanks in large measure to the Macintosh environment. ■


Table 1: *Spreadsheet performance benchmarks.*

Hardware/Software Configuration	Recalc (seconds)	Load (seconds)	Save (seconds)	Disk Storage Available (kilobytes)
Macintosh/Multiplan	7*	8	8	11.7
IBM PC/Multiplan	9.5	7	8	10.6
IBM PC/Lotus 1-2-3	3	15	13	23.1

* Keyboard data entry available during this procedure.

Paper: ◉ US Letter ○ A4 Letter ○ US Legal ○ International Fanfold [OK]
Orientation: ○ Tall ○ Tall Adjusted ◉ Wide [Cancel]
☒ Print Row and Column Numbers
☒ Print Gridlines
Page Header: &cSales Figures for the Eastern Region
Page Footer: &l&d&r&t
Left Margin: 0.75 Right Margin: 0.75
Top Margin: 1 Bottom Margin: 1

Figure 2: *Multiplan's print options are numerous. Here the Page Setup dialogue box prompts users to select a variety of print parameters. Page breaks are identified on the display, and sideways printing is supported.*

BY MARK S. JENNINGS

EVALUATING THE MACINTOSH FINDER

The Macintosh's operating system is friendly, but at what price?

The Finder: in a world of operating systems with names like MS-DOS, XENIX, and CP/M-86, the name of the Macintosh's new operating system sounds both friendly and nontechnical. That's what Apple had in mind.

Early in the Macintosh design process, Apple set an objective—to make its new computer immediately useful to a novice. Apple's computer needed an operating system that was easy to learn. To this end, Apple designed a window and mouse operating system, called the Finder, using the graphic symbol concepts the corporation had developed for its more expensive Lisa computer.

The Finder *is* friendly to the novice. People with little or no computer experience can sit down before a Macintosh and perform useful work in a short time. But users are novices only once, and more experienced computer users who are new to the Macintosh may find conventional command-oriented operating systems more intelligible.

INTERNAL ORGANIZATION

The Finder is only the top level of a multilevel Macintosh operating system. The lowest level consists of various hardware interfaces and drivers and occupies about a third of the 64K-byte ROM in the Macintosh. The next level is the user-interface toolbox, which contains a wide variety of routines for implementing complex window/mouse-based programs. This code occupies the remaining two-thirds of ROM. At the highest level of these ROM routines is the Finder program itself, stored as a disk file. The Finder has an accompanying file, called the System file, mainly used to store font images, icon images, and text messages but also some code. The Finder program manages the Macintosh's desktop. It is equivalent to the command-line interpreter part of a more conventional operating system.

The Finder is a rather large program. If it were to stay in memory all the time, little memory would be left for application programs. Therefore, the Finder is dumped from memory whenever you start an application program. This differs from most microcomputer operating systems, which stay in memory and provide an interface between the application program and the hardware. Macintosh application programs do not work through the Finder; they access the Macintosh hardware by calling the routines in ROM on their own.

When you return to the Finder, the computer essentially performs a "warm boot" and reloads the Finder from disk. This makes quitting an application program a relatively time-consuming task (often taking 15 or 20 seconds).

FINDER CONCEPTS

The Finder is built around several key concepts: the desktop metaphor, data as objects, mouse integration, and the shared user interface.

Desktop Metaphor: The computer's screen can be represented as a desktop. A number of items can be present on the screen "desk" at one time, just as you can have a calendar, file folder, and notepad on an actual desktop.

Data as Objects: Data, whether in programs or files, can be represented as objects on the desktop. You can move them around. The Finder assigns graphic symbols (called icons) to such data-objects.

Mouse Integration: The mouse is an integral part of the Finder; it controls the cursor and is your interface to the operating system. The Macintosh does not include any cursor-control keys, and you cannot use the Finder without using the mouse.

Shared User Interface: The Macintosh provides a consistent user interface for all programs. This ROM (read-only memory) interface allows different programs to share and exchange data. To run efficiently, all software must adhere to this common interface.

THE FINDER AT WORK

Suppose you want to use your Macintosh to write a letter. The basic steps are start the computer, load and run a word-processing program, and copy the newly created letter to a separate disk for backup. (I'll ignore printing the letter for the purposes of this example.)

When you first turn on the Macintosh, the screen prompts you to insert a disk by displaying a disk icon with a question mark. (You may turn the computer on with the disk already in the computer if you wish.) After you insert a disk, the desktop is set up, and an icon representing the disk you inserted is displayed in the upper right-hand

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Mark S. Jennings is president and founder of Digital Kinetics, a small firm specializing in technical/engineering software and user manual development. He can be contacted at POB 3203, Durham, NC 27705.

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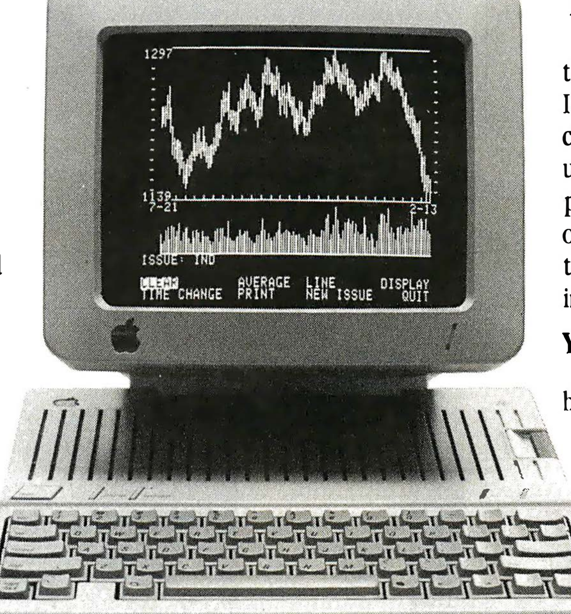
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corner of the desktop (figure 1). The name of the disk ("Write" in this example) is displayed underneath the icon. Write contains the word-processing program you will be using.

To access the contents of Write, you select the disk by moving the pointer over the disk icon and pressing the mouse button. (The pointer is a little arrow on the desktop that you move around with the mouse.) This causes the icon to darken, indicating that Write has been selected. Next, you move the pointer up to the menu bar (the top line of the screen where various menu categories are displayed) and position it over File. When you press and hold down the mouse button—an operation called "dragging"—the menu choices under File pop down from the menu bar like a window roller shade (figure 2). Since you want to "open up" the Write disk, you move the pointer down to the OPEN command and release the mouse button. This opens a window on the desktop that displays the contents of Write (figure 3).

One of the files displayed in the window is the word-processing program you want to use—MacWrite. Starting the word processor involves the same sequence of steps used to open the disk: you select the MacWrite icon by clicking on it, then you drag the File menu down to the OPEN command. This opens a new window for the word-processing program (figure 4).

After exiting the word processor, the Finder dumps you back to the desktop. As you can see in figure 5, a new icon is now visible (labeled "Smith 5/19"); it represents the document file for the letter you wrote with MacWrite.

To back this file up, you need to copy it to another disk. First you need to put the backup disk on the desktop. If you have two disk drives, you simply insert the backup disk in the second drive. If you have a single-drive Macintosh, you need to eject the Write disk by selecting the Write disk icon and selecting Eject with the File menu. You then can insert the backup disk. In either case, a new disk icon (previously labeled "Backup") representing the backup disk appears on the screen.

Copying a file involves dragging its file icon to the desired destination. In this case, you need to drag the Smith 5/19 file icon to the Backup disk icon (figure 6). The Finder will then copy the file. If you have a single-drive Macintosh, you are in for a few disk swaps. (The Macintosh always ejects a disk and prompts you for the name of the next disk it wants during disk swaps.)

Finder Performance

But how well does the Finder perform? I evaluated the Finder in seven general

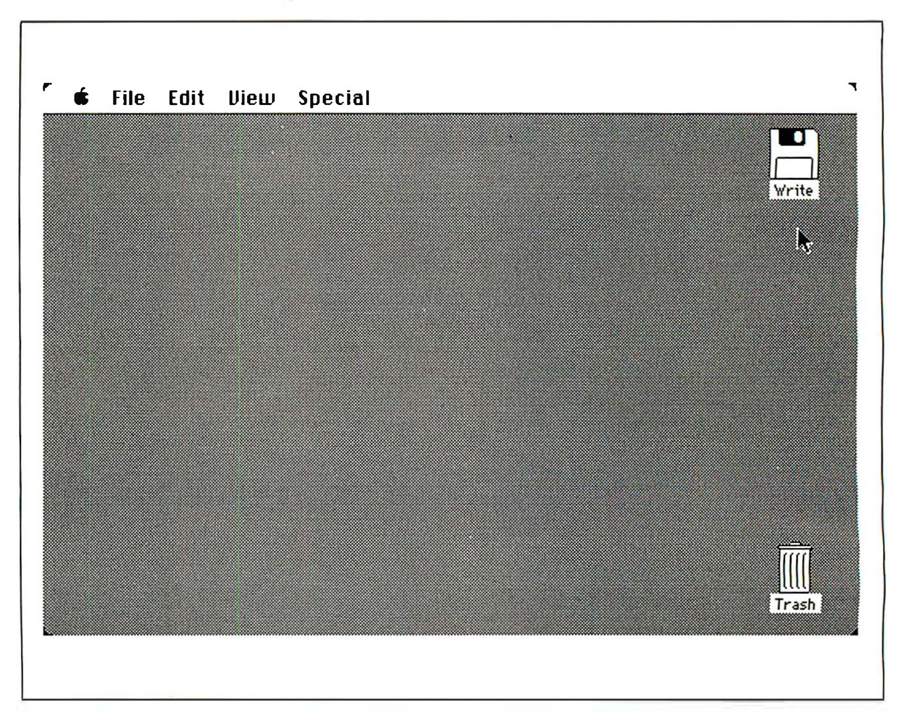


Figure 1: *The Finder's desktop. The disk icon in the upper-right corner of the desktop represents the disk used to boot the computer. The Trash icon in the lower-right corner is used to dispose of files.*

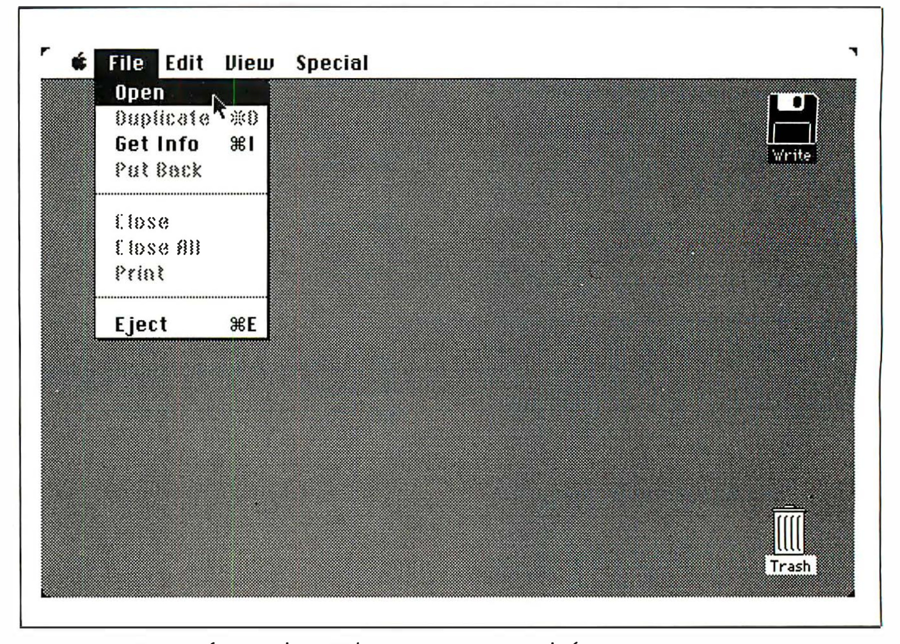


Figure 2: *Using the pop-down File menu to open a disk.*

areas: speed, ease of use, hardware insulation, flexibility, overhead, interfacing capabilities, and ease of program development.

Although this is not intended to be a rigid evaluation, with benchmarks and the like, I used MS-DOS 2.0 (running on a floppy-disk-based IBM PC) as a general yardstick for comparison.

Speed: The Finder seems very quick and responsive, as long as disk I/O (input/output) is not involved. Window operations (resizing, opening/closing, and scrolling) are virtually instantaneous.

Unfortunately, the small Macintosh memory necessitates frequent trips to the disk drive. In these cases, the Finder seems quite slow compared to MS-DOS. Opening or quitting an application program typically takes from 15 to 30 seconds (30 to 60 seconds for the round trip). MS-DOS can typically load or quit application programs in a few seconds. Inserting or ejecting a disk takes from 2 to 15 seconds of computer time depending on the configuration of windows for the disk and how many disk icons are on the "desktop." With MS-DOS, disk handling is not under software control, so no computer time is required. Finally, the Finder takes from two to fives times longer than MS-DOS to copy files from disk to disk. This disadvantage is most pronounced when comparing copy times on single-drive computers.

At times, these delays make the Finder cumbersome. For example, suppose you wanted to copy one small file to several different disks. With the Finder, you need to go through an ejection/insertion step for each disk just to get each disk icon on the screen; this can easily take 20 or more seconds of computer time per disk. With MS-DOS, you can perform this task as quickly as you can get disks in and out of the drive.

If your work keeps you in application programs the majority of the time, these delays make little or no difference. However, if you are running several different programs (especially with a single-drive Macintosh), these delays can become very annoying.

Ease of use: For novice users, the Finder is much easier to learn than MS-DOS. Most first-time Macintosh users are able to understand the basics of the Finder within an hour with little or no reference to the manual. The novice MS-DOS user had better plan on some serious study of a needlessly complex manual followed by a few tough initial hours at the computer.

While the first hour with the Finder may be bliss, later hours may not be as smooth. First, the Finder has a great deal of hidden behavior, and the nontechnical manual glosses over explana-

(continued)

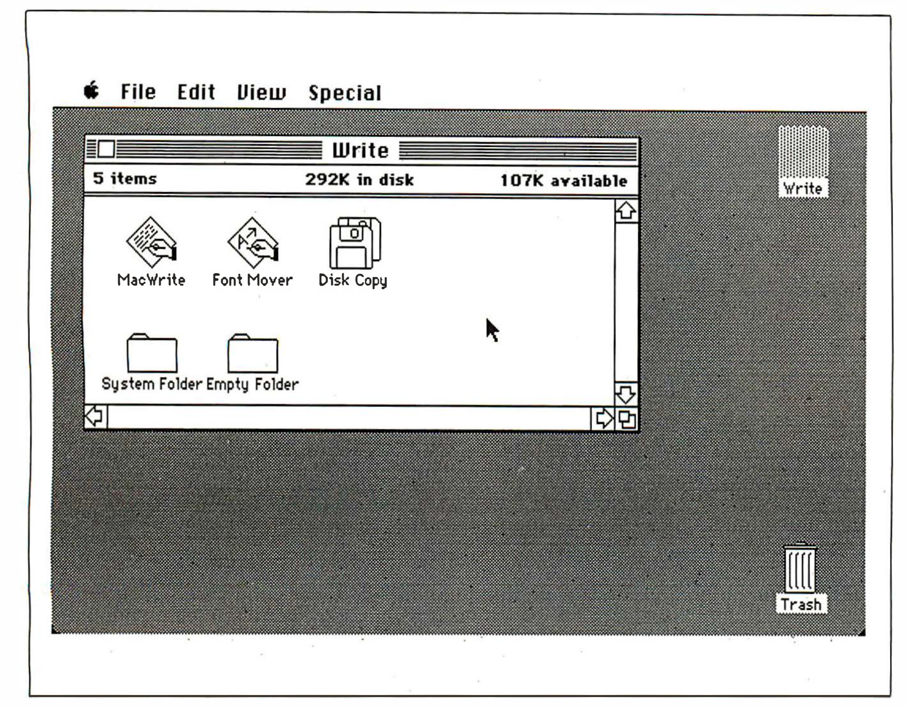


Figure 3: *The desktop after a window has been opened for the Write disk. The top three icons in the window represent application and utility programs, while the lower two icons represent folders containing files.*

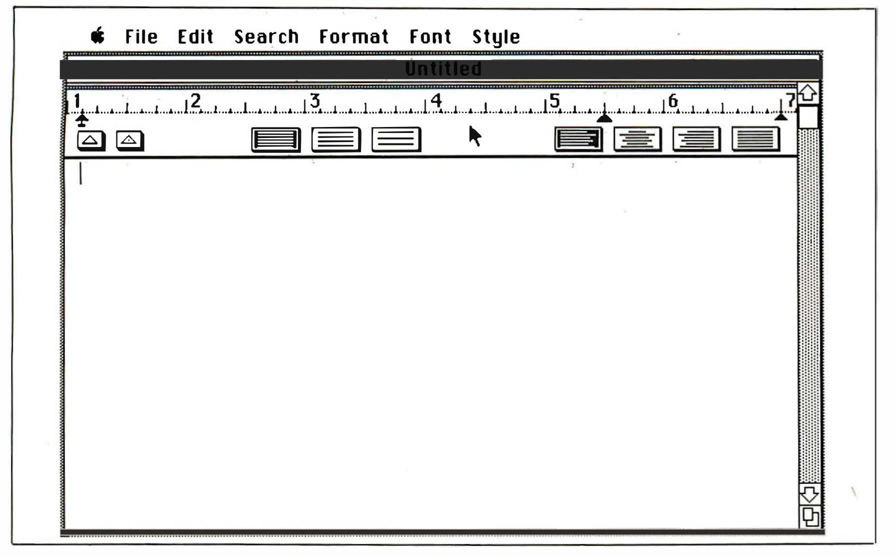


Figure 4: *The MacWrite word-processor window. The bar on the right side of the window is used to scroll the document being worked on. The box at the bottom of this bar is used to resize the window. The small box in the upper-left corner of the window is used to close the window.*

tions with an "I'd-only-confuse-you" sort of style. Second, efficient use of the Finder often requires careful technique in order to avoid memory and disk-space limitations (see the sidebar, "Tips for Single-Drive Users"). These techniques require a fundamental understanding of the Finder, which goes against its basic principles. Finally, the Finder gives up nothing to MS-DOS when it comes to cryptic keystroke/mouse sequences for a few commands (see table 1).

Hardware insulation: The Finder does an excellent job of insulating users from the Macintosh hardware. Finder users can completely ignore issues like disk formats, serial-port configuration, file buffers, and device drivers because the Finder ignores this Macintosh hardware. While MS-DOS lets you access the serial port directly from the operating system, the Finder provides no such support; you have to use a separate application program.

Flexibility: One way to make an operating system easy to use is to limit the number of things it can do. This is the Finder's approach, and it does limit its flexibility. Here is a partial list of advanced operations supported by MS-DOS that are absent from the Finder: tree directories, batch processing, automatic batch-file execution, user-directed disk repair, user-installable device drivers, RAMdisks, I/O redirection, sorting, and filters. Of course, the first release of MS-DOS did not have many of these things, and future releases of the Finder may incorporate features that will make it more flexible. But these add-ons are likely to compromise the Finder's basic simplicity.

The Finder does support a feature that allows files to be placed in "Folders," enabling you to organize your desktop in a hierarchy similar to MS-DOS's tree directories. Unfortunately, this structure extends only to the organization of icons on the desktop and does not allow you to set up separate directories, each insulated and separate from one another. This is no great problem for a Macintosh with its 3½-inch disks, because the number of files on any disk is usually small. A hard-disk Macintosh, on the other hand, may have thousands of files, and the lack of separate directories could be a problem.

Overhead: For the Finder, it can be described in a word: high. Apple has done quite a job of squeezing an incredibly complex operating system into a small amount of code, but the disk space and memory requirements tend to push the Macintosh's limited resources.

Table 2 presents a comparison of the disk-space overhead (the amount of disk space required to store the operating system) between the Finder and MS-DOS. Memory overhead (the

(continued)

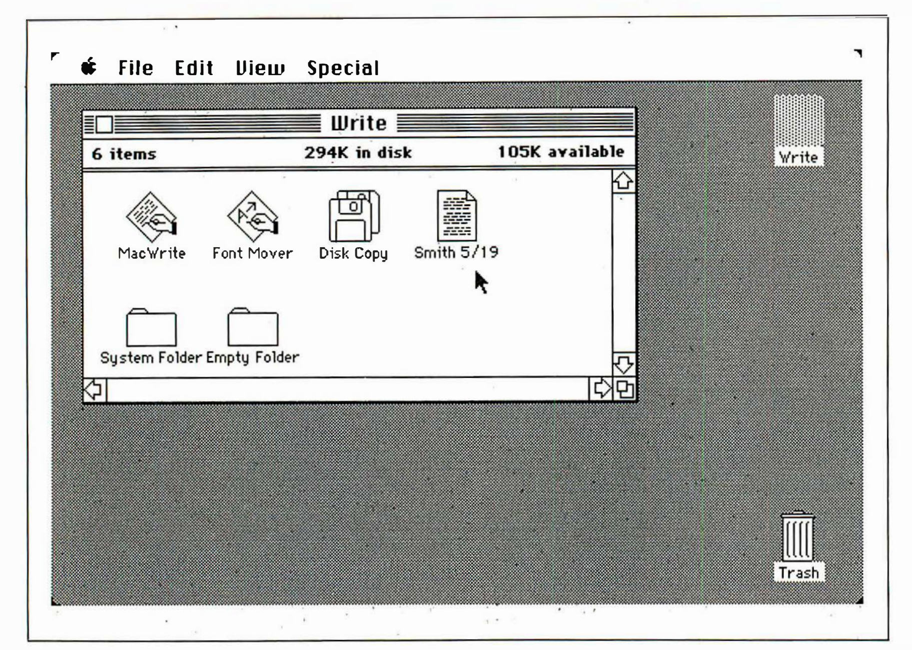


Figure 5: *The desktop after quitting the word processor. A new icon representing the letter just written is visible.*

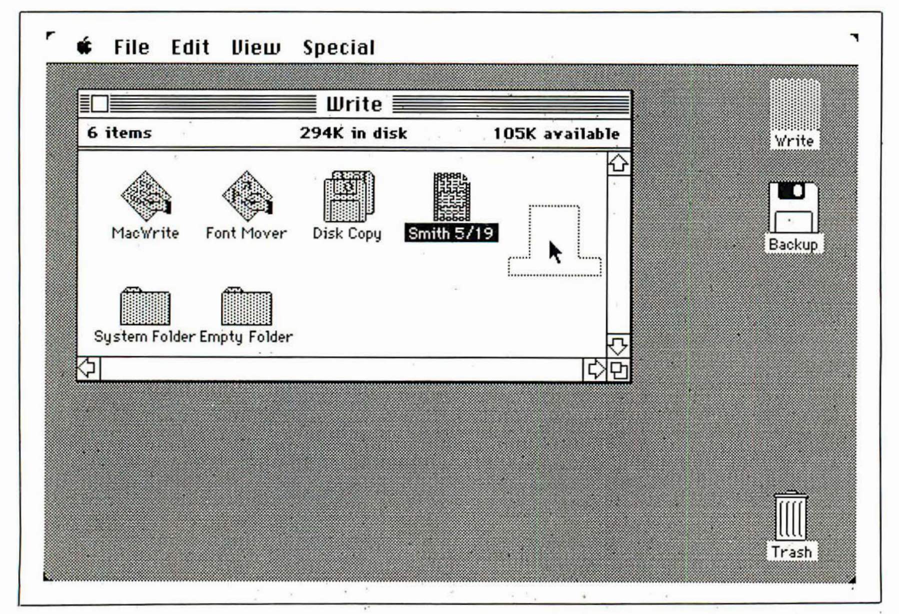


Figure 6: *Copying a file from one disk to another. The file "Smith 5/19" is dragged over to the backup disk. While in transit, the outline of the document follows the pointer.*

Tips for Single-Drive Users

Apple has been widely criticized for providing only one disk drive in the basic Macintosh. While two disk drives are definitely desirable, it is certainly possible to make productive use of a single-drive Macintosh. All it takes is attention to these techniques.

Use separate start-up disks for each major application. Because of the Macintosh's limited memory size, most application programs are not able to fit entirely in memory. Instead, the program must often go to disk, bringing in code and data. This requires that you keep the "application disk" (the disk containing the actual application program) in the disk drive nearly all of the time.

When you're ready to save the document on which you're working, the application program will typically allow you to eject the application disk and insert another data disk. While this is handy at times, it enacts a penalty of several disk swaps every time you save your work, and you should save it often. You can avoid these swaps simply by saving your work to the application disk.

To use this strategy, you need to free as much space as possible on your application disk to make room for your data files. At first, you might think that the Finder's system files (veritable disk gluttons consuming up to 230K bytes on every 400K-byte disk) would be good candidates for elimination. No way. Most application programs require frequent access to these files.

A better idea is to create separate application disks, each having the system files and a single application program. For example, to create a separate application disk for MacPaint, make a copy of your original Write/Paint master disk using the Disk Copy utility (included in version 1.1g of the Finder). Then delete everything on the copy except the system files and MacPaint. You'll end up with a stand-alone MacPaint disk that can be used to start the computer.

Using this technique (and the techniques that follow) will usually leave you with 100K to 250K bytes of open space on each application disk. This should give you plenty of breathing room for storage.

Of course, storing data on application disks is not very efficient. You can alleviate this problem by using application disks for temporary storage only; use separate data disks for permanent storage. When you quit an application, copy your document files to a separate data disk that doesn't have the system files or application program. Then you can delete your data on the application disk and make room for more files.

If you find that you frequently need to switch back and forth between two application programs (e.g., when you are cutting and pasting MacPaint images into MacWrite), you may want to have a disk with both applications. In this case, you'll probably have to keep your data on a separate data disk and endure the disk swaps every time you save the data. Try to avoid this if you can.

Use the Font Mover utility. The Finder stores character fonts (the bit maps that define the shape of each character) in the System file. Because these images take up quite a bit of disk space (138K bytes in version 1.1g) and because some users do not need all of the different fonts, a utility program, called Font Mover, is provided that allows fonts to be removed from the System file.

Deciding which fonts to keep is up to you. Keep in mind that the larger fonts offer the biggest rewards in disk-space savings. Note: certain fonts, required by the operating system, cannot be removed by the Font Mover program; they are Chicago-12, Geneva-9, Geneva-12, and Monaco-9.

Stay in application programs as long as possible. Since opening and quitting an application program are slow operations, do as much work as possible each time you run an application. For example, if you need to paste a number of images into a MacWrite document, draw all your images in one MacPaint session, storing them in the Scrapbook. This will reduce the number of times you need to open and quit an application program.

Practice good desktop housekeeping. The Finder stores a "hidden" file on each disk that gives the current status of windows for that disk. Updating this file often takes a significant amount of time, especially if you are ejecting and inserting several disks in sequence. Speed up your operations by keeping the number of open windows to a minimum.

Do all file copying at once. Every time you copy a file from one disk to another, a few disk swaps are required. If possible, postpone file copying until you can do it all at once with one copy operation. In this way, your average number of swaps per file copied will decrease.

Don't forget that the Finder has two methods of selecting multiple files. You can drag a box around the group of files (this works well when the file icons are near one another), or you can hold down the Shift key and click each file icon in turn. When you have selected all the files you want to copy, drag any one to your copy destination. Like the Blue Angels, the entire group of files will fly in perfect formation across your desktop to the destination.

Use your Scrapbook and Clipboard effectively. They are stored as disk files. Typically, they are kept in the System folder. For the most part, the Finder uses the Scrapbook and Clipboard files on the start-up disk (the disk you used initially to boot the machine).

Things can get a little tricky when you start a new application program on another disk that also has Scrapbook and Clipboard files. This will cause the new application disk to become the start-up disk. But which files will the Finder use?

Actually, the Scrapbook and Clipboard behave differently. The Clipboard is copied from the old start-up disk to the new start-up disk, replacing the Clipboard file on the new disk. This means that the Clipboard will always stay intact even if you leapfrog from disk to disk as you run different applications.

The Scrapbook, on the other hand, is not copied. Instead, the Scrapbook file on the new start-up disk is pressed into service. Thus, each disk with a Scrapbook file essentially has its own Scrapbook.

This scheme has a pitfall. A typical scenario: you draw a number of images in MacPaint that you wish to paste into a MacWrite document. After carefully storing each image in the Scrapbook, you exit MacPaint. Because MacWrite is on a different disk, you eject the MacPaint disk, insert the MacWrite disk, and open up MacWrite. To your dismay, the images you have just stored have vanished. Where did they go?

They are still around, but they're in the Scrapbook file on the MacPaint disk. How do you get around this problem? One solution is to avoid using the Scrapbook; use the Clipboard instead. But this approach can be incredibly time consuming when you need to transfer several items because of the time it takes to repeatedly open and quit each application program as you cut and paste each image.

Another method is to copy the Scrapbook file from the old start-up disk to the new start-up disk prior to starting the new application program. You do this by dragging the Scrapbook file (in the System folder) to the new disk before starting the new application program.

Use keyboard commands. The Finder includes command key equivalents for commands that are usually selected with the mouse from the pop-down menus. Many times executing these keyboard commands can be quicker than using the mouse.

Use the keyboard/mouse buffer. The Finder buffers the mouse movement/clicks and keystrokes. Since many operations are repetitious, you can often anticipate the next step and place it in the buffer in order to keep the disk drive from stopping. The computer must wait for a stopped disk drive to come up to speed before you can begin reading or writing.

—Mark S. Jennings

Table 1: *Special Finder commands. Apple touts the Finder as not requiring the memorization of any commands. As this list shows, the claim is not entirely true.*

Operation	Keystroke/Mouse Sequence
Internal disk ejection	Command-Shift-1
External disk ejection	Command-Shift-2
Create a MacPaint document of screen	Command-Shift-3
Print active window	Command-Shift-4
Print screen	Caps Lock-Command-Shift-4
Multiple icon selection	Shift-Click, or Drag a box
Move window without making window active	Command-Drag Window

Table 2: *Disk-space requirements (in bytes) to store the Finder's and MS-DOS's operating system files. The System file for the Finder will vary depending on how many character fonts are retained. The size shown assumes that all fonts on the version 1.1g Write/Paint disk are retained. Approximately 65K bytes of fonts can potentially be deleted; however, a 10K- to 20K-byte reduction is typical. The Clipboard and Scrapbook file sizes assume both are empty.*

The Finder, version 1.1g (Macintosh) Disk-Space Requirements (bytes)		MS-DOS 2.0 (IBM PC) Disk-Space Requirements (bytes)	
System	132K	IBMBIO/IBMDOS	23K
Finder	46K	COMMAND.COM	18K
Imagewriter	17K		
Clipboard	1K		
Notepad	2K		
Scrapbook	1K		
Total	199K	Total	41K

Table 3: *Minimum recommended Macintosh software development system. This system allows the development of stand-alone Macintosh software that can take control of the entire desktop. The cost of this system (June 1984) is approximately 50 to 100 percent higher than comparable MS-DOS development systems. (Apple has a Certified Developer Program that provides for substantial discounts for qualified commercial software developers. However, delays of several months in obtaining equipment have been typical.)*

Item	List Price
Macintosh computer	$2495
Imagewriter printer	$ 495
Lisa 2/5 computer	$4495
512K-byte memory card for Lisa	$1495
Imagewriter accessory kit for Lisa	$ 50
Lisa Pascal Workshop	$ 595
"Inside Macintosh" Manual (draft)	$ 150
Macintosh software supplement to Lisa Pascal Workshop	$ 100
Total	$9875

amount of memory used by the operating system that is unavailable to application programs) is roughly similar. The Finder's memory overhead is about 22K bytes, compared to about 25K bytes for MS-DOS. (This 22K is only the part of the operating system that stays in memory while the application is running; the Finder program itself is much larger.) Of course, 22K bytes tends to cut deeper on the Macintosh than it does on a typical IBM PC with a lot of RAM; the Macintosh is limited to 128K bytes of RAM (random-access read/write memory), and the display takes 21K bytes of this.

Interfacing capabilities: The Finder includes a simple but powerful system of exchanging text and graphic images between different application programs. MS-DOS has no comparable system. The Finder's system consists of two separate but complementary storage areas called the Clipboard and the Scrapbook. The Clipboard stores a single text passage or graphic image and is used as a temporary storage area for cutting, copying, and pasting operations. The Scrapbook, which can store many text passages or images, allows you to set up a library of frequently used items. Both are designed to be easily accessible from application programs, provided the programs are designed with the Clipboard and Scrapbook in mind.

The system works well. Its only drawback is slowness; both the Clipboard and Scrapbook are stored as disk files and access can be tedious.

Ease of program development: For noncommercial software developers, the Macintosh has (or will shortly have) a variety of innovative and easy-to-use interpreters in BASIC, Pascal, and Logo. If your program does not require the speed of a compiled program or large amounts of memory, the Macintosh, with its superior program-development and debugging capabilities, is a great machine. But MS-DOS is a better choice for large, complex programs that must run quickly. Don't expect to see something as powerful as Lotus 1-2-3 running on a 128K-byte, single-drive Macintosh.

Commercial software developers, who typically want to develop high-performance, stand-alone, compiled programs, share a problem. Macintosh software development requires a significant

Flaws in the Finder

The first released version of the Finder (version 1.0) had a number of bugs. In May 1984, Apple released a revised version (1.1g) in which nearly all of the bugs have been fixed.

Version 1.1g of the Finder includes a number of enhancements.

- You can now select an application program as a "start-up application," and the program will boot into the application. (Note: it is not obvious how you "deselect" a start-up application. Simply begin by selecting the Finder file in the System folder as the start-up application.)
- A disk-copying utility drastically reduces the number of swaps required to back up a complete disk on a single-drive Macintosh.
- There have been several changes to the character fonts provided.
- The routines for copying files between disks have been improved so that fewer disk swaps are necessary for a single-drive Macintosh.
- Superscripts and subscripts have been added to MacWrite.
- A draft printing option has been added to MacPaint offering quicker printing at some reduction in resolution.
- A FILL command has been added to MacPaint, which assists filling in designated areas with patterns.

Macintosh owners can upgrade their Finder, free of charge, by bringing their original Write/Paint disk to their Apple dealer. Included with the upgrade are new versions of MacPaint and MacWrite.

For the record, a list of all bugs I have run across (for both Finder versions) follows. Many are very difficult to reproduce since they occur intermittently.

Bugs in Version 1.0

Burn disks. Rarely, the Finder will suddenly refuse to accept a previously acceptable disk. Any attempt to insert the disk (either as a start-up disk or as a disk to add to the desktop) results in a "System Error—ID=02" message indicating a memory-addressing problem. Attempting to boot from the offending disk generates a scowling Macintosh icon with the memory address 0F0064. The machine must be rebooted with a different disk.

Jumbled display. Rarely, dragging a disk icon to the trash will cause the display to jumble, and the machine will lock up. The computer must be rebooted to regain control.

Lost disk space. Rarely, duplicating an application program on a nearly full disk and then deleting the duplicate will cause loss of disk space. When this occurs, the Finder will erroneously give you the message "Out of memory—dispose of a dimmed icon," even though you have only a single-disk icon on the desktop. At this point, the Finder will not let you start an application program or copy files. The computer must be rebooted.

Continuous disk swapping. Occasionally, the Finder will become confused during disk swaps. It will keep requesting the same disk over and over even though you are inserting the correct disk, or it will endlessly thrash back and forth requesting the same two disks. Rebooting is the only exit.

Lost Scrapbook pictures. The Scrapbook routines have a bug that will cause the message "Picture is too big to be displayed here" to be shown for a Scrapbook picture even though the picture easily fits the Scrapbook page size. Interestingly, pictures that really are too big will often be cropped at their edges, indicating that this message should never appear.

Bugs in Version 1.1g

Wrong Clipboard file icon. If you dispose of the Clipboard file in the System folder, the Finder will regenerate the file when you access the Clipboard. This is what it should do; however, the disk icon symbol will be incorrect. It should be a system file; instead, it comes up as a document file. This minor bug also occurs in version 1.0.

Misregistered display. Very rarely (I experienced it twice in approximately 100 hours of computer operation), copying an application program to another disk will cause the display screen to suddenly become misregistered (images will be distorted and blurred). The computer may allow you to do an operation or two, but it eventually crashes with a "System Error—ID=25" message and must be rebooted.

—*Mark S. Jennings*

investment in terms of time and money. Programming is complex. Apple has not done a good job of distributing quality technical documents. Currently, you need a Lisa system to develop standalone application programs (table 3).

Conclusions

The Finder provides an excellent environment for the novice computer user, and nearly everyone will find it fun to work with. It does especially well in providing a graphic representation of your data and programs. And the Finder's method of exchanging data between application programs is innovative and powerful.

The Finder's weaknesses are not as obvious, but just as real. For one, the system seems . . . well, ponderous might be the best word. Simple tasks often seem to occur in slow motion as the Finder shuttles back and forth to disk for code and data. The lack of any batch-processing capability means repetitious command sequences must be clicked or keyed in each time they are needed. But these drawbacks are largely academic if you stay in application programs most of the time. The window/mouse concept works beautifully in programs like MacPaint, MacDraw, and Microsoft Chart; it just doesn't seem to come off as well with the Finder.

Specialized application-program support is also a weak area for the Finder. The Macintosh is not an easy system to develop programs for, and Apple has compounded the problem by failing to provide quality technical information and software tools for the small software developer. The common applications will be well served by giants like Microsoft, but don't expect commercial programs for managing your bowling league any time soon. The Finder is definitely not the operating system for the hacker.

More than anything, the Finder, like the Macintosh, is an enigma. It is an extremely elegant operating system that is seriously flawed because Apple did not provide sufficient memory and disk storage in the basic Macintosh. (Apple's decision to limit the Macintosh to 128K bytes—and to solder the chips directly to the main digital board—is unfathomable.) Too often, the Finder simply overwhelms the hardware. With 512K bytes and double-sided disk drives, the Finder will probably perform effectively. Until then, it will continue to attract new people to computers and frustrate users who need to get a lot of work done quickly. ■

HABADEX ON APPLE'S MACINTOSH

BY LÉO LAPORTE

Habadex is a time-management system for Apple's Macintosh personal computer. It combines a telephone directory, an auto-dialer, and an appointment calendar in a single program that fits neatly onto your Mac "desktop." Although Habadex does most of what you'd want it to, some of its features behave in unexpected ways, and some of them don't behave at all.

Some of Habadex's problems can be traced to the fact that it was one of the first programs released for the Macintosh. In the scramble to publish the program, Haba Systems obviously skimped on product testing. The first version was buggy and lacked some vital features. Even the scheme used to copy-protect the Habadex disk didn't work! An update offered free to registered users has cured most of the original bugs and added some features (including working copy protection) but has done nothing to eliminate what I consider the program's basic flaws.

The 86K-byte Habadex program comes on a single copy-protected disk. Two data files, one for the directory and another for the calendar, are also on the disk, although they may be transferred to another disk for added data storage space. Haba Systems tells me that Habadex can also be used on a hard-disk system.

HABA'S DATABASE

Habadex's phone directory is something like a small database, already defined to contain 19 fields of varying length. Although you can rename these fields and move them around on the data-entry form, you cannot lengthen or shorten them, nor can you add or delete fields. Each directory entry takes up about 300 bytes on the disk. The number of entries in your directory is limited only by the amount of space free on your disk.

Despite its resemblance to a database, the directory isn't nearly as useful. To find someone's phone number, for instance, Habadex forces you to use the somewhat ungainly method of first sorting the directory on one of eight fields, then clicking the appropriate tab on the side of the directory to open it to the right page. For example, to find a correspondent with the last name Walker, you'd need to arrange the directory by last names and then click the W tab. Walker would be buried on the page among the 18 other entries there. If you have a lot of W entries, you'll have to scroll around to find the name, using Habadex's awkward nonstandard scroll bar system.

Data is entered by clicking the New Record box on the directory book and filling in the blanks on the data-entry form that appears. After you have entered a record, you must select the ACCEPT command from the File Menu,

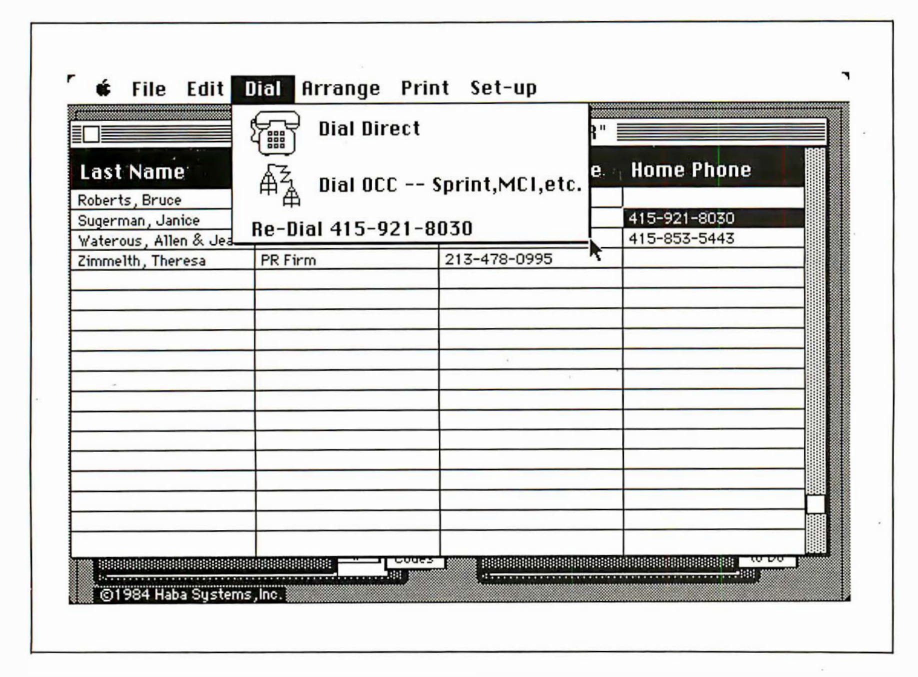


Figure 1: *Once you select a phone number by pointing to it and triple-clicking the mouse button, Habadex can auto-dial the number. The Dial menu is pulled down here to show your options.*

Perhaps the company should have spent more time studying the possibilities of the Mac's user interface

or type COMMAND-A to save the data and continue. By the time you've entered 20 or 30 records. you can expect a delay of several seconds after each COMMAND-A. That's not the only inconvenience, though. There's worse to come because Habadex's programmer has ignored the Mac Commandments.

In an effort to unify the way programs work on the Macintosh, Apple has built into the machine's ROM (read-only memory) a raft of useful routines and documented them in great detail in the Mac's technical bible, *Inside Macintosh.* Chief among these routines is a nifty text-editing package that most Macintosh programs use whenever text must be entered or edited with the mouse and keyboard. Haba Systems seems to have decided it could do better. The company has totally ignored the Macintosh editor and instead used its own (substandard) editing routines throughout the program.

Why not use the existing Macintosh user interface, one that all Mac users already know? Worse still, some operations that seem like standard Mac operations are not. Habadex lets you cut, copy, and paste text but doesn't save it on the clipboard, so that, while you may think you are copying something onto the clipboard for use in another program, you aren't really. Habadex only remembers it internally—you cannot transfer information between Habadex and another program.

If you survive your experiences with the Habadex text editor, you will have a directory full of names, addresses, phone numbers, and other miscellaneous information. One of the features that makes Habadex more useful than the usual paper-based phone directory is its auto-dial capability (see figure 1). Using the mouse, you can select a phone-number field, then instruct Habadex to dial it for you using your Hayes-compatible modem or a $49.95 auto-dialer from Haba Systems. Habadex can even remember your Sprint or MCI number and tack it onto the front of the phone number along with your access code. There is also a Quick Dial screen for frequently called numbers.

A couple of caveats, though: first, even with a modem capable of pulse dialing, Habadex works only with Touch-Tone systems. If you are in a pulse-dialing area, or your office PBX requires pulse to dial out, you will not be able to auto-dial. Second, if you opt for the Habadex auto-dialer, you may have to make some aural sacrifices.

The dialer is a small box that connects your phone to the Macintosh sound jack and your telephone wall jack. Because plugging into the Mac sound jack cuts off the internal speaker, Haba Systems' dialer has a small built-in speaker. It sounds terrible. To use the dialer, you have to turn your Macintosh sound up to at least level four, in some cases louder. This makes the small speaker sound loud and strained. It didn't take me long to unplug mine and put it in the closet. Anyone who attempts to use this device in an office will likely do the same. So much for auto-dialing.

The Habadex directory sports two reference screens: the first contains telephone area codes arranged by number; the second contains zip codes for each state, also arranged numerically. You may find these of some use. At any rate, it's a thoughtful touch.

The Appointment Book

Moving right along to the right side of the screen, you find the Habadex appointment book. Here you can keep track of appointments, travel, and expenses on a calendar for 1984 and 1985. (Presumably updates will extend this calendar for those still using the program in 1986.) The appointment book also has a page for special occasions and things to do. On the face of the appointment book are the date, time, your next two appointments, and top two things to do (see figure 2).

To open the appointment book, you click on a month tab. You'll see something similar to the familiar wall calendar (sans pinup, though), with each day marked with your first two appointments and any travel plans you have entered. To look at the day in more detail, you move the pointer to it and click. Each day has room for 14 appointments, plus a line on which to indicate travel and five lines for recording the day's expenses. There is currently no way to extract expense or travel information or to print any calendar information, short of the standard Macintosh Command-Shift-4 that prints the whole window.

The appointment calendar (see figure 3) keeps your appointments in chronological order, no matter how you entered them, and their appearance on the front of the appointment book is very convenient. When it's time for an appointment, your Mac will beep loudly and persistently 15 times—enough to ensure that even the comatose won't miss any important engagements. Of course, you can turn the sound off on the Apple control panel, but then you can't use the auto-dialer. Decisions, decisions.

The things-to-do list is also handy. Keeping it updated is simple, and as long as you don't exceed the limit of 21 things to do, you should find it a useful reminder. When you've completed a task, you can use the mouse to put a big, satisfying check mark next to it.

Habadex's programmer, Gary Crandall, has done a nice job of simulating a real-world appointment book, but the only way to really make use of it would be to keep Habadex up and running on

(continued)

Léo Laporte is a San Francisco radio personality who programs an Eagle and an Atari. He has just purchased a Macintosh. He can be reached at 1177 Polk St., San Francisco, CA 94109.

AT A GLANCE

Name
Habadex 1.1

Type
Telephone directory and appointment calendar software

Manufacturer
Haba Systems Inc.
15154 Stagg St.
Van Nuys, CA 91405
(818) 901-8828

Format
3½-inch disk

Language
Pascal

Computer
Apple Macintosh

Price
$199.95

Documentation
48 pages

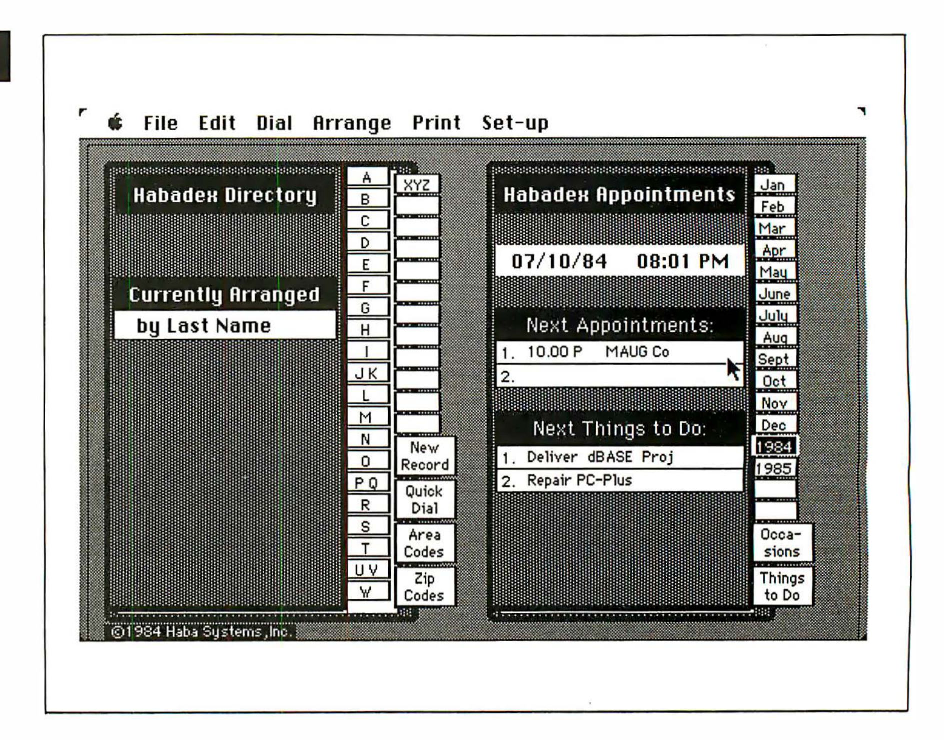


Figure 2: *Habadex's main screen provides quick access to all of its functions. The time and date, your next two appointments, and top two things to do appear on the face of your appointment calendar. Clicking on the tabs on the side of either of the two books opens that book to the appropriate page.*

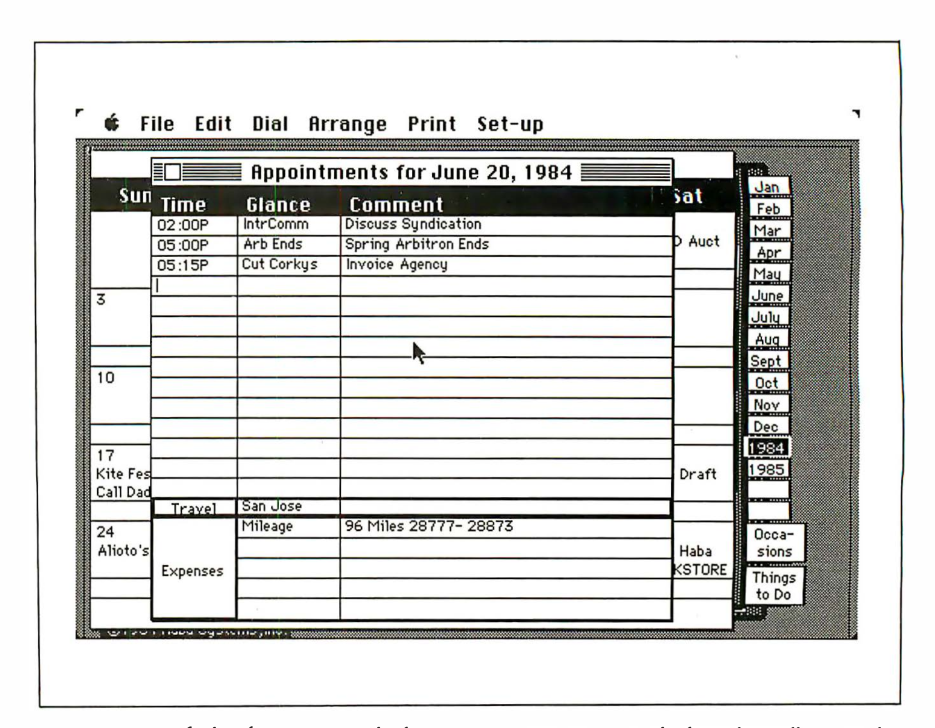


Figure 3: *Habadex keeps a record of your appointments, sorted chronologically. Travel and expenses can be entered as well, but there's no way to prepare an expense report from the information stored here.*

your Macintosh all day, making the Mac one of the world's most expensive desktop diaries going. Of course, since the Macintosh doesn't allow true multitasking, it's not really Crandall's fault. Perhaps this is not an application well suited to this computer.

Mailing Lists

The tedious job of preparing mailing lists and form letters is one almost any computer is well suited to. In this case, it is the software that falls short. Habadex can print mailing labels and prepare form letters using data from your phone directory. It's here that the program is at both its best and worst.

The way you set up your mailing labels is a good example of the power of a mouse-based interface. Using the mouse, you can arrange the information on the label and set up how the labels will print with real facility. Habadex lets you design, and will remember, three different label formats.

Once you've designed your labels, you can print them in any font. The labels can be printed alphabetically by first or last name, city or state, profession, or company, or numerically by account number or zip code. You can print on labels of any size, and from one to three across. Like MacWrite, however, Habadex supports only the 80-column Imagewriter printer.

Habadex also can make lists of the entries in your phone directory, and here, too, you can design the report form using the mouse. Habadex makes a usually difficult and time-consuming task easy by taking advantage of the Macintosh's visually oriented interface.

Mail-Merge

I wish I could say the same of the Mail-Merge utility. Here is Habadex at its worst. Mail-Merge is used to integrate data from your directory into form letters created by MacWrite. The result is *far from pretty*.

To use Mail-Merge you must copy the body of a letter created by MacWrite onto the clipboard. (It's ironic that, while Habadex expects other programs to allow transfer of text via the clipboard, it doesn't do so itself!) During a Mail-Merge, Habadex adds the current date, an address from your directory, and the word "Dear" followed by the data field of your choice. It then prints the text from the clipboard. You cannot incorporate data into the body of the letter.

The letters themselves look badly misformed. The date is printed flush-left at the top, followed by an inexplicably indented address. Your salutation follows, flush-left again. Habadex mishandles letters that are right-justified. It also ignores tabs.

In short, Habadex's Mail-Merge is awkward, inflexible, and essentially useless for all but the most undemanding tasks.

Habadex's documentation is a 48-page booklet—about the size of MacPaint's. It is indexed and nicely typeset, with very clear illustrations.

At $200, Habadex seems overpriced and underpowered. Many of its functions work awkwardly. The program has, at best, ignored and, at worst, abused the Mac user interface. Even if it worked flawlessly, I would have some doubts about its superiority over a paper-based system.

The way you set up your mailing labels is a good example of the power of a mouse-based interface.

Computer pioneer and visionary Alan Kay has said that the Macintosh is the first computer good enough to be criticized. Apple has set a hardware and software standard the rest of the world will now strive to match. It may be inevitable that the first few companies that try will fail. Had Habadex been released at any other time, for any other computer, it would have been met with praise. Apple's Macintosh has changed all that. Habadex is too little, too early. ■

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BY DAVID D. REDHED

THE LISA 2: APPLE'S ABLEST COMPUTER

No other machine in Lisa's price range approaches its versatility, innovation, and power

The 11 different operating environments available on Lisa fall into three broad categories: business applications, business applications plus software development, and those used purely for software development.

Lisa may be the most underrated machine in the history of the microcomputer industry. The recently introduced Lisa 2 line is more versatile and powerful than any other machine in its under-$7000 price category. In spite of this, the technical press remains preoccupied with Macintosh and the public remains enthralled with IBM.

Granted, Apple's marketing efforts on behalf of Lisa 2 have been less then herculean. And a dearth of software support still hobbles the entire Lisa line. Yet I see Lisa as the premier Apple offering. I've taken the time to look closely at this innovative, and now cost-effective, computer. There is simply no other machine in Lisa's price range that approaches its versatility, innovation, and power.

The three Lisa models—Lisa 2, Lisa 2/5, and Lisa 2/10—differ only in the amount of attached hard-disk storage they offer (none, 5, and 10 megabytes, respectively). The least expensive model, the Lisa 2 ($3495), is akin to a wide-screen Macintosh with half a megabyte of main memory. The unit also sports a single 3½-inch disk drive (400K-byte capacity) for external storage. The only apparent purpose for this stripped-down Lisa is to provide a vehicle that will run Macintosh software with four times the memory capacity of the Macintosh. No other commercially available software will run on the Lisa 2.

The Lisa 2/5 ($4495) adds an external 5-megabyte hard disk. The 2/10 ($5495) provides an internal 10-megabyte hard disk.

When it comes to expanding Lisa's hard-disk capacity, there are many ways to go. The Lisa 2 and 2/5 can be upgraded to 2/10 status for $2795. The Profile drive on an upgraded 2/5 can be connected through a parallel card ($195) for a total of 15 megabytes of storage. A 20-megabyte system can also be configured using all Apple disks for $8680. There is one external parallel port on both the Lisa 2 and the 2/5 that is intended as the connection point for the 5-megabyte Profile drive. This port (the default port) is internal in the 2/10, since the hard-disk drive is internal. Any additional drive must always connect via a parallel card, whether it is augmenting a Profile drive or a 10-megabyte drive. Lisa now supports a 70-megabyte drive manufactured by Priam and distributed by Tecmar. UNIX and XENIX users have the option of attaching drives from Corvus and Sunol in sizes from 20 to 100 megabytes.

All models of Lisa have two serial ports intended for use with printer and modem. Currently, no printers other than the Apple-provided dot-matrix and letter-quality printers run with Apple-developed software. Both the ImageWriter (dot-matrix) printer and the letter-quality printer connect through the serial ports (the Macintosh software expects a dot-matrix printer to be connected to serial port B only). UNIX and XENIX users have other printer options.

Lisa 2 has three expansion slots for peripheral cards. So far, however, only three such cards exist. Apple sells a parallel card providing two ports, and Santa Cruz Operations sells a serial card

offering four ports. The Apple card is used primarily for attaching additional Profile drives but was originally used to support the first Lisa dot-matrix printer that required a parallel interface. The serial card is primarily used for supporting terminals under multiuser (UNIX or XENIX) operating systems. The Priam disk is attached through a special-purpose interface card.

Unlike Macintosh, Lisa has both a high-resolution bit-mapped display and a character-generator display that supports a standard 24 by 80 screen. Having a standard screen-display option permits some conventional software to run on Lisa without display output conversion. This feature is critical to XENIX and UNIX users.

Lisa Operating Environments

The 11 different operating environments available on Lisa fall into three broad categories: those supporting business applications, those supporting business applications and software development, and those used purely for software development.

Three distinct user environments focus on business applications only. These are the Office System with fully integrated applications, the Office System with QuickPort applications, and an application-oriented shell running under the Lisa Operating system.

The original Lisa software consisted only of applications that were fully integrated into the Office System. The QuickPort applications available on Lisa 2 are a new kind of application that share some, but not all, of the Office System facilities. The Lisa operating system also supports multiple shells for the purpose of creating separate user environments.

The Office System contains three elements: Desktop Manager, LisaGuide, and Lisa 7/7, a seven-function integrated program. Desktop Manager is actually a user-oriented operating system placed on top of a conventional operating system. The icons and windows and all of the actions taken to manipulate them are part of the Desktop Manager. LisaGuide is a tutorial program designed to familiarize users with Lisa's graphic interface. Lisa 7/7 is Apple's attempt to offer an integrated package like Lotus 1-2-3. Given its greatly reduced price of $695 for all seven functions, 7/7 should be a competitive piece of software. Current owners of Lisa Office System software can upgrade to the new release for $150.

The seven functions provided include:

- LisaCalc, a 255 by 255 spreadsheet
- LisaDraw, presentation-quality graphics drawing
- LisaGraph, graphs of discrete functions
- LisaList, to display rows of two-dimensional tables
- LisaProject, a cost, time, and resource scheduling program
- LisaTerminal, a communication utility
- the LisaWrite word processor

These applications are called "fully integrated" because they have access to all the Desktop Manager facilities. The seven functions provided in Lisa 7/7 include window support, pull-down menus, keyboard and mouse support, and the transfer of different kinds of data between the various applications.

Apple now considers Lisa 7/7 a complete integrated office application. In fact, Apple has discontinued support for the Toolkit, the development tool required to produce fully integrated applications. That is not a very encouraging outlook for developers or for users who want extensions to the Office System.

Software developers do have an alternative. It is called QuickPort. As the name implies, this utility provides a quick way to transport software into the Office System. QuickPort applications execute in a window on the desktop but do not have pull-down menus and associated mouse interactions. The window may be divided into two panels,

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PHOTOS BY J.C.M. DOWNS

Photo 1: *The Lisa 2 is an aesthetically attractive machine that occupies a minimum of desk space. An internal 10-megabyte hard disk provides plenty of storage. Those needing less storage capacity can purchase the machine with an external 5-megabyte Profile hard disk.*

one for text and one for graphics. The contents of the graphics panel can be copied onto the clipboard and pasted into any application that can take graphics information from a LisaDraw document. Information from the text panel of the window can be copied to the clipboard and taken to any application that can receive text lines (e.g., LisaTerminal or LisaWrite).

Business Applications and Software Development

Four distinct operating environments support both program development and business applications. Those are MacWorks, the Workshop from Apple Computer, UNIX from UniPress, and XENIX from Santa Cruz Operations under license from Microsoft. MacWorks is simply a program that allows Lisa to run Macintosh software. The Workshop is very similar to the UCSD Pascal system. UNIX and XENIX both use shells to provide a command-driven user interface to an underlying operating system. Users must already have or be willing to develop proficiency in computers before they can readily operate in any of these last three environments.

When you start up Lisa under MacWorks, a portion of the Macintosh operating system adequate to handle disk I/O is loaded into memory. In fact, the equivalent of the 64K-byte operating-system ROM is loaded and made accessible in a manner that is transparent to the Macintosh applications. From this point on, Lisa 2 functions just like a Macintosh, with two major exceptions—the display screen is larger and the central processing unit is slower. Lisa's display area is physically larger than Mac's (10½ versus 8 inches diagonally). It also has more pixels in both directions (720 by 364 versus 512 by 342), and the pixels are shaped differently. The pixels in Lisa 2 are 50 percent higher than they are wide. Macintosh pixels are square. These differences combine to provide a larger working area. Unfortunately, Macintosh graphics appear to be stretched in the vertical direction when run on Lisa. Text looks surprisingly good, but circles become ellipses and squares mutate into rectangles. Most nonmathematical shapes are acceptable in appearance, but if you create graphics on Lisa 2 using MacPaint, you are in for a rude surprise. When you print the results, the printer will show the true form of the object, not what is on the screen.

The central processor on Lisa runs at 5 MHz versus 8 MHz on the Macintosh. The 5 to 8 ratio holds for graphic operations, but the ratio is 5 to 6 for most other operations.

The MacWorks program, first available in April 1984, would not function with Lisa's hard disk. A version released in September 1984 permits use of the Profile drive, and Mac files will coexist with Lisa Office System and/or Workshop files. (They will not coexist with UNIX or XENIX files.) Attempts by Apple to develop utilities for file transfer between Macintosh and Lisa applications have not been successful. Developing programs using Macintosh BASIC or some other high-level language is practical on Lisa because of the extra available memory. However, these programs must be small enough to run in the Mac's restricted memory.

The Workshop

Because the Workshop's user interface is similar to UCSD Pascal's, Apple II or III Pascal users will feel at home rather quickly. The program contains many features not found in UCSD Pascal, including a mouse-driven editor and sophisticated file-manipulation facilities. The Workshop contains all Lisa and

Table 1: *Lisa 2/5 and 2/10 performance figures.*

Measured times in seconds	Empty LisaWrite file 2/5	2/10	Ratio 2/10 to 2/5	37,000-byte LisaWrite File 2/5	2/10	Ratio 2/10 to 2/5	Empty LisaDraw file 2/5	2/10	Ratio 2/10 to 2/5	40,000-byte LisaDraw File 2/5	2/10	Ratio 2/10 to 2/5
Test run immediately after start-up												
Open first time	29	25	0.9	33	28	0.8	34	27	0.8	98	90	0.9
Save and put away	15	20	1.3	63	51	0.8	14	16	1.1	13	14	1.1
Open second time	4	3	0.8	7	6	0.9	6	5	0.8	69	66	1.0
Set aside	6	3	0.5	7	6	0.9	6	5	0.8	8	8	1.0
Test run after two other applications are active												
Open first time	37	29	0.8	39	31	0.8	36	26	0.7	100	86	0.9
Save and put away	16	16	1.0	52	51	1.0	10	10	1.0	13	12	0.9
Open second time	5	4	0.8	7	6	0.9	7	5	0.7	68	70	1.0
Set aside	6	4	0.7	7	7	1.0	6	5	0.8	8	8	1.0
Save a duplicate	12	14	1.2	16	20	1.2	10	9	0.9	18	13	0.7
Copy disk to hard disk	3	3	1.0	17	15	0.9	4	3	0.8	16	15	0.9
Copy hard disk to disk	4	3	0.8	18	20	1.1	4	4	1.0	20	20	1.0

Macintosh software-development tools supported by Apple Computer. Since Pascal is the underlying language of Lisa software, all of the operating-system interfaces are in Pascal form. A 68000 assembler is available that can be used to create programs and procedures to run in the Pascal environment. A C compiler is also available, and procedures written in C can be called from Pascal (or vice versa). Both the Pascal and C compilers have an option to generate code for either Lisa 2 or Macintosh.

In releases 1.0 and 2.0 of the Workshop, Apple offered the BASIC Plus language (compatible with Digital Equipment Corp. BASIC) and Cobol (an extension of ANSI 74). Only BASIC will be offered under release 3.0, but Apple will offer no technical support. COBOL has been dropped due to an insufficient number of buyers.

Using the Workshop with Pascal, C, and the 68000 assembler, you can develop conventional keyboard-oriented applications. Further, by using a multitasking operating system, QuickDraw graphics utilities, and the mouse interaction utilities supplied by Apple Computer, you can create any kind of environment you like. You can duplicate all the visual effects and user-interface features you see in the Office System with the utility software supplied in the various elements of the Workshop.

Extensive documentation of QuickDraw (the comprehensive graphics package used in the Office system) is included, along with some sample programs. The documentation of the operating-system interfaces is also good, and access to low-level information through these interfaces is excellent.

UNIX

The UniPress Inc. version of UNIX is based on Bell Labs System V UNIX. The operating system is supplied with a C compiler, standard UNIX utilities, and Berkeley enhancements (visual editor, C shell, terminal independent library). The entire package sells for $1495. Hard disks from 20 to 100 megabytes are supported, and Ethernet networking is also available. Corvus and Sunol are the vendors of the hard disks that can be

(continued)

AT A GLANCE

Name
Lisa 2

Manufacturer
Apple Computer Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010

Size
13.8 by 18.7 by 15.2 inches; 48 pounds

Power Requirements
90–130 V AC, 48–68 Hz (U.S. model)
180–260 V AC, 48-68 Hz (foreign model),
150 watts (both models)

Processor
MC68000, 5-MHz clock

Interface Slots
Three slots for peripheral interface cards

Peripheral Connectors
All models have a mouse connector, keyboard connector, and two serial-port connectors (25-pin D-shaped plugs). The Lisa 2 and 2/5 also have a parallel connector intended for connecting a hard disk (25-pin D-shaped plug)

Keyboard
2.7 by 18.7 by 6.5 inches;
4 pounds

Memory
524,288 bytes (½ megabyte) standard for all models; expandable to 1,048,576 (1 megabyte)

Mass Storage
All models have one Sony 3½-inch drive with a 400,000-byte capacity; Lisa 2/5 has a 5-megabyte external Profile hard-disk drive; Lisa 2/10 has a 10-megabyte internal hard-disk drive

Video Display
12-inch diagonal tube with a displayable area of approximately 8 by 6 inches; 720 pixels horizontally and 364 pixels vertically; 90 pixels/inch horizontally and 60 pixels/inch vertically (pixels are 50 percent higher than they are wide); bit-mapped graphics page requires 32,760 bytes; screen refresh rate is 60 Hz; horizontal line rate is 22,900 Hz; dot rate is 20 MHz

Options
Parallel interface card with two ports (25-pin D-shaped plugs)

Hardware Prices

Lisa 2:	$3495
Lisa 2/5:	$4495
Lisa 2/10:	$5495
Conversion of Lisa 2 or 2/5 to a 2/10:	$2495
Conversion of original Lisa to a 2/5:	$595
½ megabyte memory:	$1495
Parallel interface card:	$195
ImageWriter dot-matrix printer:	$595
Daisy-wheel printer:	$2195

Software Prices for Apple-Supplied Software

Lisa 7/7: (contains Desktop Operating System, LisaCalc, LisaDraw, LisaGraph, LisaList, LisaProject, LisaTerminal, LisaWrite)	$695
Upgrade from version 2.0 of the Office System applications:	$150
Pascal Workshop:	$395
MacWorks:	$195

purchased through UniPress as part of a complete package for Lisa. UNIX will also work with hard-disk systems supplied by Apple.

Several applications programs are available from UniPress: the EMACS editor system, the LEX word processor, UNIFY database, /RDB Database Tools, and the Phact ISAM file system. Of

The Lisa Office System

In July 1984, Apple released version 3.0 of all the Lisa software. What used to be marketed as seven integrated applications is now called Lisa 7/7, a single application with seven functions. The operating system is included for $695, and release 2.0 owners can upgrade for $150, even if they do not own all seven applications.

The seven functions available in Lisa 7/7 cover all the common activities in the business office, with the exception of accounting. The Lisa series of integrated programs can calculate, draw, graph, sort and maintain lists, make projection decisions, communicate at 110 to 19,200 bps (bits per second), and do word processing.

The Programs

LisaCalc is a spreadsheet calculator that offers you a 255 by 255 matrix, natural-order evaluation, and up to 126 data digits visible on the screen. The program locates circular references and each column of the spreadsheet may have a different width. The spreadsheet also performs calendar-date calculations.

The 3.0 version of LisaCalc adds the natural-order evaluations and circular references as well as internal rate of return, a display of both storage requirements and recalculation time, and an option to print with any combination of headings, grid lines, and row and column titles.

LisaDraw is especially suited to presentation graphics. Its maximum document size is four feet by eight feet, and it will print along either axis of the paper. Images are stored in mathematical form and can be easily edited and resized.

Lisa's 3.0 release of LisaDraw offers color output to Canon's color printers for the first time. You can also print up to an 11-inch boundary. Your images can be rotated, flipped, and reduced up to 25 percent.

LisaList offers users an elementary relational database, eight data types (text, number, social security, zip code, date, time, telephone, and cost). You can sort your data on multiple columns in ascending or descending order and can search the list in any of six ways. Columns can be added or deleted, and any column can be hidden from display.

Version 3.0 of LisaList offers some increase in integration.

LisaGraph offers the same table of values as LisaCalc, 255 by 255. You can draw full-page, half-page, and quarter-page and can reduce the document to fit the display screen. Under LisaGraph, you have seven graph types—point, line, bar, stacked bar, 3-D bar, pie, and area.

The stacked bar, solid bar, and area graphs are new with version 3.0 and so is the display of linear regression and line correlation coefficient. You can also use color output to Canon's new color printer and add text anywhere on the graph.

LisaProject is a task and cost scheduler performed with Pert-chart-like diagrams. Resource and task bar charts and task cost charts are derived automatically from the schedule chart. The critical path is calculated and displayed, as are early-start/early-finish and late-start/late-finish. Fixed costs may be specified for each task and a maximum of five labor resources.

The task cost charts are new with version 3.0, as is the ability to specify resource costs and project those costs onto resource and task charts. You can also fix task costs in this new iteration of LisaProject.

LisaTerminal supports XON/XOFF protocol and can communicate anywhere from 110 to 19,200 bps. A window contains all transmissions, and you can scroll backwards. You can maintain multiple connections and switch back and forth between them. You can also retain custom transmission setups. Version 3.0 of this program offers very little that is new.

Under LisaWrite your document size is limited only to the amount of hard-disk storage available. Multiple type sizes and proportional spacing are available to you. On-screen rulers let you adjust the margins of your copy, and LisaWrite's search facilities include case and wild-card options.

Add to the above features an 80,000-word spelling checker available in version 3.0 and a 750-word extension for words of your own.

Using Lisa 7/7

The Lisa programs are integrated in three distinct ways: they each work from a common user interface; data can be transferred between most, but not all, of the modules; and you can suspend activity in one program and activate any other.

With its uniform programming conventions, Lisa's 7/7 really excels. Text-editing conventions are identical across all modules and in all circumstances. Whether you are naming a document, entering text in a document, or supplying a set of characters to search a document, you edit text in the same way. Also, the pull-down menus of Lisa are used in all functions and always operate the same way.

The various data-transfer paths are shown in figure 1. Table 1 shows you the data formats that each of 7/7's functions can create, receive, and/or send.

Lisa's ability to switch quickly between programs is a direct consequence of the multitasking operating system. Under 7/7, your current function is deactivated when you switch to another program. No matter how long you stay away or how many other functions you activate in the meantime, returning to the original program will recapture the state at which it was

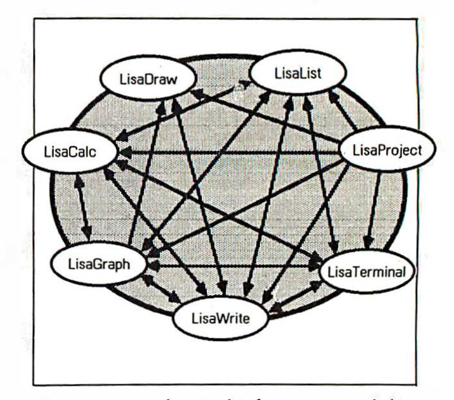


Figure 1: *The paths between modules along which data can be transferred.*

course, many other applications are available for UNIX, but not necessarily through UniPress. The UniPress system contains standard UNIX development tools such as a C compiler, text processor, utilities, and the multiuser kernel. By nature UNIX is a multiuser system. A single-user run-time system is

(continued)

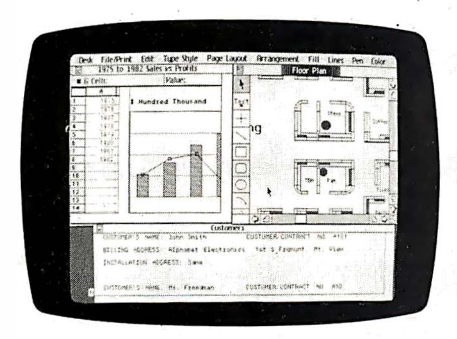


Photo 1: *Three windows in Lisa showing different functions: LisaDraw, LisaWrite, and LisaGraph. LisaDraw is currently active.*

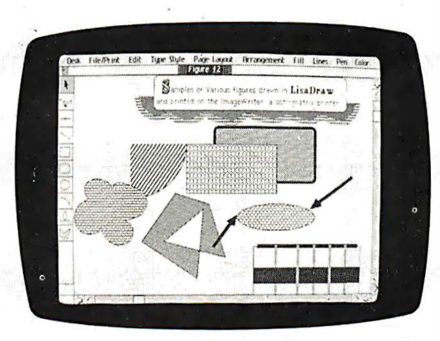


Photo 2: *A sample of figures created by LisaDraw.*

Table 1: *Types of data that a Lisa 7/7 program may create, receive, or send.*

	Text	A Table	Graphics
LisaCalc		Create Receive Send	
LisaDraw			Create Receive Send
LisaGraph		Create Receive Send	Create Send
LisaList		Create Receive Send	
LisaProject		Create Send	Create Send
LisaTerminal	Receive Send	Receive Send	
LisaWrite	Create Receive Send	Create Receive Send	Receive Send

Text = one or more multiple-line paragraphs separated by carriage returns

A Table = multiple lines of text containing tabs and separated by carriage returns (tabs indicate columns and carriage returns indicate rows)

interrupted.

This same kind of switching applies if you activate the identical function on different documents. Thus you could have three or more word-processing documents in progress and switch back and forth between them without disturbing the states of any of them. This kind of integration is very difficult to achieve with conventional microcomputer operating systems.

Photo 1 is a screen display of three windows belonging to three different functions of Lisa 7/7: LisaDraw, LisaGraph, and LisaWrite. The dark shading around the name "Floor Plan" indicates that this is the currently active window created by LisaDraw.

Successively activating the other two functions and returning to "Floor Plan" takes a total of 14 seconds. This is contrasted with the approximately two minutes it took to open all three documents initially.

In a similar manner, if one LisaGraph document is closed and another one is opened, the only time required is that taken to load the new document and connect LisaGraph to it. The LisaGraph program is already in memory and does not have to be reloaded. In this case, the new document is displayed in a new window in just 20 seconds, in contrast to the 43 seconds for the first document opened by LisaGraph.

Obviously, the megabyte of memory in Lisa will hold only so much; then things must be moved out to make room for additional documents or functions. Even with small documents, all seven functions will not fit in memory simultaneously. I have found that three functions with moderate documents (5 to 10 pages) or two functions with fairly large documents (15 to 25 pages) will cohabit memory without requiring significant swapping to the hard disk.

Lisa 7/7 is a powerful package for the price—$695. With a Lisa 2/5, the extra ½-megabyte of memory, and a dot-matrix printer, the total system price comes to about $7300. If the functions in Lisa 7/7 satisfy your requirements, there is not a better buy.

—David D. Redhed

also available as an option ($495), however. Additional languages that can be used with the system include FORTRAN, Pascal, BASIC Plus, RM COBOL, SMC BASIC Four, and Irvine Ada.

XENIX

XENIX for Lisa 2 is based on UNIX System III and is available from the Santa Cruz Operation. The system includes the full set of XENIX utilities, the C shell, the full-screen visual editor, system-administration commands, electronic mail, and support for UNIX networking. XENIX also provides "vsh," the visual shell that serves as a menu interface.

Conversion to the Lisa 2

By the time this is published, most owners of the original Lisa will have converted to the Lisa 2. There are three parts to the conversion process: getting all your files ready to be converted, making the actual hardware modifications, and updating to the new system software.

The most troublesome (and potentially risky) part of the conversion is getting all your files on the Profile drive before converting the hardware. This is necessary because the new system does not have any software drivers for the old 5¼-inch disk drives. If you convert and then find some files you forgot, there is no easy way to recover them. For everyone except developers the hardware conversion is done by a dealer. (Developers are given the kit to make the conversion themselves.) It involves swapping the old 5¼-inch Apple drives for the new 3½-inch Sony drive, swapping some integrated-circuit chips, and cutting one or two resistors off a board. In my case, the conversion went very smoothly.

The last step is to update the Profile drive with the new system software. All Lisa 2 conversion kits contain release 2.0 of the Lisa software system, which involve modifications down at the disk-directory level. When you update the drive, all the file-formatting changes are made at the same time, although users are not really aware that this is happening.

Once you have converted, you are unable to do a disk-to-disk copy; you must go through the Profile drive as an intermediate step. —*David D. Redhed*

From one to four Profile drives can be supported by XENIX in addition to the 10-megabyte built-in disk of the Lisa 2/10. Support for other disks is not currently available, but future releases will include support for Priam and Sunol drives. XENIX will support two additional terminals through the two serial ports on Lisa. Santa Cruz Operations provides a four-port serial board to go into the standard Lisa slots. Up to two of these may be used to support as many as eight terminals.

Networking is supported through two separate features, "uucp" and "Micnet." The uucp feature provides point-to-point communication between predetermined locations. Micnet is a full networking facility for user-to-user communications between a variety of locations. The XENIX Software Development System can be added to the basic operating system described earlier. This package supplies the C compiler and various utilities to support the production of C programs, including an interactive debugger and a source-code control system.

Software Development Only

Lisa 2 and Macintosh software development done by Apple so far have taken place entirely on Lisa, and the tool development by Apple has been extensive. Pascal Workshop is the host environment for all development work, and there are four separate development tools currently available. QuickPort is used to move conventional applications into the Office System. Macintosh Supplement is used to develop Macintosh software. The Toolkit is an unsupported system used to develop fully integrated applications for the Office System. Pterodactyl Software supplies an IBM BASIC Compiler with utilities that is used to convert BASIC programs written for the IBM PC for use on Lisa.

QuickPort supplies a window on the Desktop in which non-Desktop-integrated applications can execute in a conventional manner while gaining several of the Desktop features. All of the window management and icon manipulations that are part of the Desktop environment are available to users. Inside the application window, there is no support for pull-down menus or mouse functions. Any applications desiring those features will have to provide all the graphics, menu handling, and mouse interaction. All of the utility software to do these things is supplied in the Workshop via Pascal units. This means that each developer will have to produce his own set of logic to create a user interface. It is not even possible to take advantage of existing functions used by the current Desktop applications. (These belong to the Toolkit environment.)

The positive side of QuickPort is that conventional applications that are brought over to Lisa and converted to run under the Workshop can be run on the Desktop with a minimum of changes. QuickPort is actually an application developed with the Toolkit—an application designed to run other applications. Quickport programs may consist of any combination of Pascal, C, and assembly-language code. Once a program is running in the Workshop, it can then be packaged using a special set of libraries supplied by Apple. This new package is then installed in the Office System.

Each application automatically has a portion of its window devoted to text display, and the ordinary WRITELN and READLN functions of Pascal are routed to the window. You can copy text to or from the clipboard just as with any other desktop application. In addition, you can split the window into scrollable portions, either horizontally or vertically. The application may specify a buffer size to control how much information is kept available for scrolling backwards. Optionally, an application can request a portion of the window to be set up for graphics. Any QuickDraw graphics performed by the application will be displayed in the designated portion of the window. The contents of the graphics panel can be copied out to any other desktop application that is capable of accepting graphics information (e.g., LisaDraw, LisaWrite). Thus, QuickPort is a valuable tool if you want to quickly get an application into a partial Lisa desktop environment. The Toolkit and QuickPort are the only development tools that produce software for the Desktop. Applications created with other tools, excluding those for Macintosh, must run in conventional operating environments like the Lisa

Workshop, UNIX, or XENIX.

The Macintosh Supplement to the Workshop consists of additional libraries of routines to support the development of Macintosh software. The standard Pascal compiler, code generator, and linker all have options to support Macintosh development. This supplement, along with documentation called *Inside Macintosh*, is available to interested parties willing to pay $250.

The development approach involves creating the source code on the Lisa 2, compiling it, and then transferring object code to Macintosh for checkout. This transfer is typically done by creating a Macintosh disk on Lisa. An alternate route is through a direct communication line connected to the serial ports.

IBM BASIC COMPILER

A BASIC compiler for the Workshop, available from Pterodactyl Software, converts IBM PC BASIC programs to run on Lisa. Compiled into 68000 code, converted programs should run considerably faster on Lisa than on a PC. Given the 1-megabyte Lisa memory, applications could be modified to run substantially larger problems than on a PC. Communication programs are also available from Pterodactyl to transfer code from the PC to the Lisa.

PERFORMANCE

Lisa has taken hard knocks for performance, and not without justification. The first release of the Office System software was quite slow when doing I/O (input/output). Version 2.0 of the software, which improved the I/O speed quite a bit, was released in January 1984. I have not seen any comprehensive comparisons, but company claims indicated a 60 percent reduction in time for certain operations. My experience

(continued)

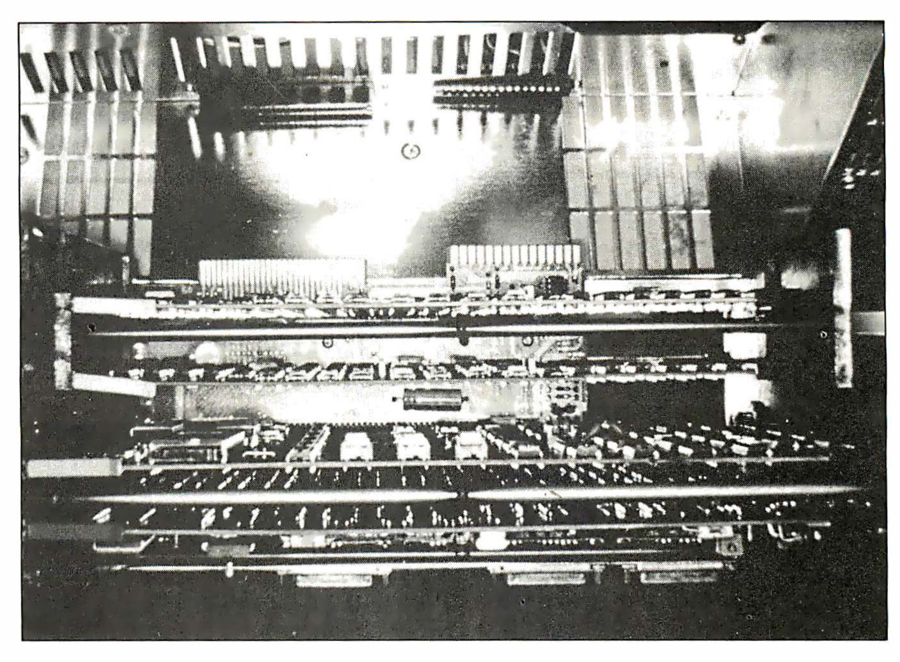


Photo 2: *The four printed-circuit boards that make up Lisa's electronics are mounted in a sandwich within the card cage. Two memory boards, a CPU board, and an I/O board are included. All assemblies are color-coded and easily removed for servicing.*

Table 2: *Pascal I/O benchmark results.*

Test #	Description	Time in seconds 2/5	Time in seconds 2/10	Ratio 2/10 to 2/5
1	Write 1024 text lines of 8 bytes each (WRITELN)	11.0	11.8	1.1
2	Read 1024 text lines of 8 bytes each (READLN)	6.5	6.4	1.0
3	Write 8 text lines of 1024 bytes each (WRITELN)	8.0	9.3	1.2
4	Read 1024 text lines of 8 bytes each (READLN)	4.8	5.0	1.0
5	Write 1 text line of 8192 bytes (WRITELN)	8.1	9.0	1.1
6	Read 1 text line of 8192 bytes (READLN)	5.8	6.2	1.1
7	Write 8192 bytes in a single block (BLOCKWRITE)	1.5	2.3	1.5
8	Read 8192 bytes in a single block (BLOCKREAD)	1.4	1.4	1.0
9	Write 100 records of 100 bytes each (sequential PUT)	73	78	1.1
10	Read 100 records of 100 bytes each (sequential GET)	1.4	1.4	1.0
11	Read 100 random records of 100 bytes each (random GET)	5.8	7.4	1.3

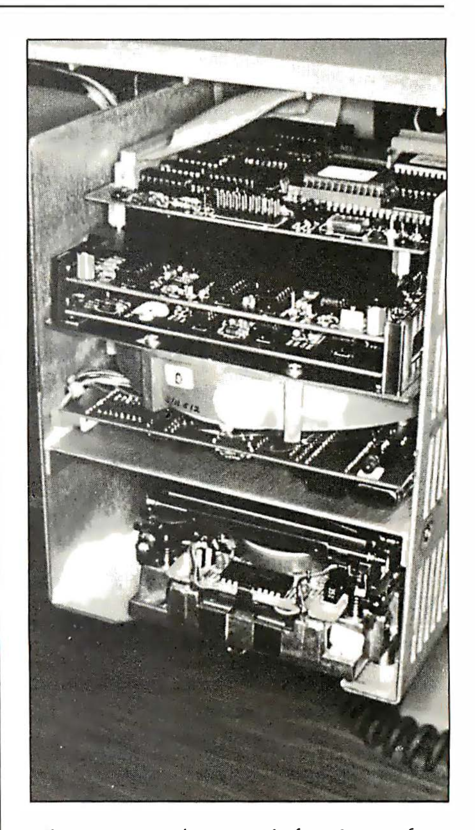


Photo 3: *A close-up of the 10-megabyte drive and the Sony Micro-drive on the Lisa 2/10.*

The industry may end up adopting Lisa technology in small pieces over the next few years.

is that the average improvement was more like 40 percent.

Table 1 contains some of my own performance figures for the Lisa 2/5 and 2/10. The 10-megabyte disk was 10 to 15 percent faster for most operations. All these tests were run under the Office System, release 2.0. Release 3.0 is not supposed to have any performance improvements, but I have not been able to verify that the performance is unchanged.

When trying to evaluate the performance of the Office System in absolute terms, you should take several things into account. "Opening a document" in Lisa includes more activities than in most systems. The 33 seconds required to open a 37,000-byte LisaWrite document for the first time after system startup made me wonder what exactly was going on. Actually, I discovered, quite a bit. First, the LisaWrite program is being brought into memory and activated. Second, a copy is made of the requested document. In Lisa you never work on the original. Since opening an empty document still takes 29 seconds, initiating LisaWrite accounts for most of the time required by the larger document. Note that opening the same document the second time takes just 7 seconds.

An additional factor affecting performance is the underlying overhead of a fail-safe system. The Lisa Office System is capable of recovering all the data files on the hard disk even if the main catalog is lost or damaged. This is accomplished by redundant storing of enough information to rebuild the entire directory. This fail-safe mechanism adds significantly to I/O times. You might argue that you would rather risk an infrequent loss of data than suffer speed degradation on each and every I/O operation. That, however, is a system design issue and not a valid criticism of system performance.

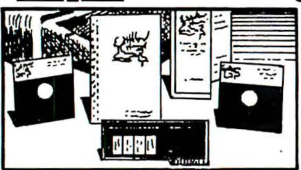
I also ran some tests on the 2/5 and the 2/10 for 11 different Pascal I/O operations. Here the 10-megabyte disk was never faster than the Profile drive (contrary to the Office System results). Most operations were about 10 percent slower, and one operation was 50 percent slower. Table 2 shows the individual results along with a characterization of the type of Pascal I/O used. I am unable to reconcile these results with those from the Office System tests. I can only assume that the difference is due to a different kind of I/O logic used by the Desktop Manager.

CONCLUSIONS

It's fair to say that Lisa 2 gives its owners the freedom to run a wide variety of operating systems and applications. Its large memory and ability to use several sizes of hard disks are major factors in its versatility. Lisa's uniqueness as new technology has faded. And though Macintosh has pushed Lisa into the background, it may actually spur interest in Lisa over the long term. Further, until Macintosh is supplied with more memory, Lisa is the only practical way to run even moderately large Macintosh applications.

So far, Apple Computer does not seem inclined to market the Lisa aggressively or to give full support to Lisa software. In spite of this, I continue to think that the technology represented by the Office System is a giant step forward. It may well be that while the industry is not able to embrace it totally, it will end up adopting Lisa technology in small pieces over the next few years. ■

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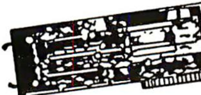
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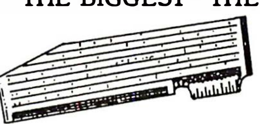


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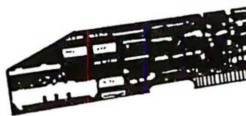
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THE FIRST LOOK AT FORTH ON THE MAC

Creative Solutions has put some unique features in a language that can be frustrating for the beginner

BY GREGG WILLIAMS

Charles Moore, the inventor of FORTH, once said, "FORTH is an amplifier. A good programmer can do a fantastic job with FORTH; a bad programmer can do a disastrous one." If that is true of FORTH (and I think it is), it is even truer of FORTH on a powerful machine—in this case, the Apple Macintosh.

FORTH is an unconventional language used to write complicated programs that run faster and fit in less memory than comparable programs written in, say, BASIC or Pascal. In FORTH you write short programs called *words*, then write more words that use the words just defined until you have a word that represents your entire program. Although FORTH is not as compact or fast as assembly language, you can (usually) write FORTH words that execute assembly-language instructions; in this way, you can further increase the speed of FORTH words that are used most often.

MacFORTH is best used by people with a detailed knowledge of both FORTH and the Macintosh hardware. The less you know about either subject, the longer it will take you to learn MacFORTH. Even though I know FORTH well, I don't know the inner workings of the Macintosh. I crashed the system dozens of times before I learned how to use MacFORTH correctly.

The style of a given implementation of FORTH resembles the FORTH standard that it most closely follows; MacFORTH draws from the FORTH-79 standard.

MACINTOSH + FORTH = MACFORTH

A plain FORTH on the Macintosh would be of little interest. MacFORTH is interesting because it (fairly) easily allows you to manipulate the features that make the Macintosh exciting: windows, menus, graphics, and mouse-driven input. (The computer makes these manipulations using FORTH words that directly call the 68000 QuickDraw routines in the Macintosh ROM Toolkit. This means that the computer's response to such commands is very quick.) Here are some of the main features of the language.

Windows. You can create a window in as few as three lines of code. Such windows can display both text and graphics; optionally, you can specify a word that executes when you "open" the window (by clicking the mouse cursor in the window). Windows can have both close and size boxes. (This version of MacFORTH does not give you access to Macintosh

(continued)

Gregg Williams, a senior technical editor at BYTE, *edited and wrote for the* BYTE FORTH *issue* (*August* 1980). *He can be reached at* POB 372, *Hancock,* NH 03449.

AT A GLANCE

Name
MacFORTH Level 1, version 1.1

Type
Token-threaded 68000 code with separated heads (see text box for details)

Manufacturer
Creative Solutions Inc.
4801 Randolph Rd.
Rockville, MD 20852
(301) 984-0262

Format
3½-inch hard-jacket disk, unprotected

Computer Needed
Standard 128K-byte Macintosh

Documentation
260-page users manual, wire-bound

Price
$149

Audience
Advanced programmers

"buttons" or the horizontal and vertical scroll bars.) Once they have been created, you can move, resize, or close these windows, just as you would any Macintosh window—MacFORTH does this automatically. MacFORTH does *not* redraw the contents of a window that has been partially covered and re-exposed; however, you can program a window to do that yourself.

Given a window called W1, you can assign it a specific behavior with the phrase

```
W1  ON.ACTIVATE
        WINDOW.ACTION
```

where WINDOW.ACTION is a FORTH word defined as follows:

```
: WINDOW.ACTION
   IF <code executed when
         window activated>
      ELSE <code executed when
            window deactivated>
   THEN
;
```

The window will then execute a specified sequence of FORTH words when it is activated and another sequence when it is deactivated.

Graphics. MacFORTH allows you to draw lines, arcs, and hollow or filled polygons and ovals. You can easily change the "color" (pattern) of the "ink" used in drawing, and you can create your own "ink colors." MacFORTH also automatically clips, scales, and rotates the drawn image to your specification. You can specify that images and text be drawn to a window in one of several modes: copy, logical OR, logical XOR, or clear-bits (dots in the source image cause corresponding dots in the destination window to be cleared rather than set).

Menus. You can add a pull-down menu to the menu bar with about 10 lines of code that define the contents of the menu and the FORTH words that will execute when you choose a selection. You can modify the contents and the behavior of the menu while a program is executing, as well as add or remove check marks, disable certain selections (turning them gray), and add or delete menu selections.

The Mouse. You can track the location of the mouse cursor, change its shape, and sense the state of its button. Given these abilities, the mouse becomes just another input device that can be used to control the behavior of a running

MacFORTH's Internal Structure

FORTH, like other languages, can work in one of several ways; the most common method is called indirect-threaded code. In such FORTH systems, a word is stored as the character string signifying its name followed by pointers to the address of the other FORTH words that make up the new word's definition (I'm simplifying here).

MacFORTH is a token-threaded language with separated heads. *Token-threaded* means that the FORTH words composing the new word's definition are pointed to by tokens, not addresses. In the Macintosh, addresses take 4 bytes, while token size is up to the designer. The MacFORTH creators decided on a token size of 2 bytes, which saves an impressive 2 bytes for every word used in a definition but still allows a maximum of 65,536 words (surely a reasonable limit) to be defined in the system.

Separated head means that the character string representing the name of the word being defined (called the *head* or *header*) is stored in a different area from the definition of the word. One possible use for separated heads is to reduce the size of a completed program by throwing away all the headers except the one used to start the program running. (The space saved can be considerable, especially when you have hundreds of words with long, meaningful names such as DRAW.MENU.BAR .)

Separated heads are also used to create *vocabularies* in MacFORTH. By separating related words into vocabularies, you make them easier to manage and prevent possible word-naming conflicts. In MacFORTH, the bodies of all words are stored together in a data structure that takes memory from the Macintosh heap; only the headers are separated into dictionaries. The resulting system appears to the user as a traditional dictionary structure but uses Macintosh memory in a more versatile way. —*Gregg Williams*

program.

Disk I/O

Most FORTHs use screens (blocks of 1024 characters) to store FORTH programs or, sometimes, data. These screens are usually written directly to disk, totally ignoring the file structure that is usually associated with the host computer. (This is usually bad because it means that the information in the FORTH screens cannot be used by other programs.)

MacFORTH screens are stored in standard Macintosh document files, which have icons that look like a page of paper with the upper-left corner folded down. Although this choice is anathema to some FORTH purists, it has several advantages: groups of screens can be named, several unrelated sets of screens can exist on the same disk, a single disk can contain both the FORTH language itself and files of screens, and screen files can be copied and moved exactly as other Macintosh files.

Data Files

I am fond of saying of FORTH, "The good news is that you can do anything in FORTH; the bad news is that you will probably have to do it yourself." In most FORTHs, you have to write your own words that allow you to use FORTH screens to store data; you can create libraries of words that implement sequential, random-access, or indexed file structures.

MacFORTH does this for you; it implements three file types: fixed, text, and virtual. *Fixed files* have records of a predetermined length and can be read or written in any order. *Text files* are records of variable length ended by a carriage return; they must be read and written in order. *Virtual files* are arbitrary streams of characters; you can begin reading and writing at any character position, and you are responsible for organizing and retrieving your data in a meaningful way. All the file types are easy to use. Together, they remove a traditional weakness of FORTH implementations.

Miscellaneous Features

Believe it or not, most FORTHs don't include words for numeric and string input ("FORTH can do anything but . . ."). MacFORTH includes words for both, as well as a handful of words that make string manipulation easier than it is in other FORTHs.

MacFORTH gives you several words to manipulate the time and date (to the nearest second) as given by the internal Macintosh clock. It also includes words that manipulate the Macintosh speaker and serial port. You can easily print text and graphics to the Imagewriter, and the MacFORTH manual gives you hints on using other serial printers with your MacFORTH program.

Two features I used briefly are debug/trace and the user-specified error handlers. The former allows you to get the name of each FORTH word as it executes and a picture of the FORTH stack; the latter allows your program to try to recover from errors that would normally abort the program (division by zero, for example). The trace feature is of limited use because it gives you two lines of output after *every* FORTH word that is executed; since most FORTH words are defined in terms of other FORTH words (often from six to ten levels deep), this indiscriminate tracing gives you more detail than you need. The feature would be more useful if you could specify which words (or how many levels deep) generate output.

MacFORTH allows you to create simple tones through the Macintosh speaker. If you have access to the Apple *Inside Macintosh* documentation, you should (according to the MacFORTH documentation) be able to do multiple-voice music and human speech.

Performance

No review would be complete without a benchmark program to argue about. Table 1 shows the results of BYTE's infamous Sieve of Eratosthenes (see BYTE, January 1983, page 286). MacFORTH compares favorably to several FORTHs running compiled 68000 code

(continued)

Table 1: *The Sieve of Eratosthenes benchmark for various machines and languages.*

Computer	Operating System	Language	Time (seconds)
68000 8 MHz	None	Assembly language	0.49
68000 8 MHz	Sun PM68K ROS	Telesoft Pascal	4.28
IBM PC (8088)	DOS 2.0	Microsoft FORTRAN 3.20	23.7
68000 8 MHz	MSP68000	Hemenway FORTH	27.0
Macintosh	1.1g	MacFORTH	36.2
IBM PC (8088)	DOS 2.0	MMS FORTH	55.3
IBM PC (8088)	DOS 2.0	BASICA	2002.1

MacFORTH Levels 2 and 3

By the time you read this review, Creative Solutions will have two new products available, MacFORTH levels 2 and 3. Level 1 is seen by Creative Solutions as being "for the hobbyist or those just getting started with the Macintosh." Level 2, which costs $249, is intended for "the professional who will be using MacFORTH in his/her work." It includes a 68000 assembler, a floating-point package (most FORTHs work with only fixed-point arithmetic), and a richer set of words that give you *full* access to the Macintosh Toolkit routines (horizontal and vertical scrollbars, for example—a useful window attribute that is not supported in level 1). You will probably need to buy and study the massive two-volume reference work *Inside Macintosh* from Apple (it costs $150 and is very difficult to read).

Level 3, for professional program developers, will "allow you to do all of your program development and then generate run-time-only versions of your product," according to Creative Solutions. Level 3 costs $2500 and includes a limited licensing agreement and extensive help from the Creative Solutions staff.

—*Gregg Williams*

on machines running at 8 MHz (the same speed as the Macintosh).

DOCUMENTATION

The printed MacFORTH manual is 299 pages long. It includes six tutorial chapters on using the main features of MacFORTH (windows, screen editing, graphics, and menus), six reference chapters, and a 118-page glossary that briefly defines the words included with the system (800 of them!). Unfortunately, the definitions of many words are unclear, incomplete, or inappropriate (the latter is true when the glossary includes words that are not supported in this version of MacFORTH).

The manual (which was written on and printed with a Macintosh) is well-written and relatively error-free. (This last is because of MacFORTH users' reporting errors in the first version of the manual.) Also included is an interactive computer-aided tutorial program called "Going FORTH" that runs on the Macintosh.

Finally, MacFORTH (according to its documentation) supports interaction with other Macintosh programs through text-type documents. Unfortunately, the documentation does not explain how to do this. The MacFORTH screen editor can cut and paste text data to the Note Pad, Gallery, and Scrapbook if the text is in lines of 64 characters or less, each line ending with a carriage return. Studying the editor's source code (included) might produce some clue on how to exchange information with other programs.

CAVEATS

FORTH derives much of its power from its philosophy of giving the user complete access to (and responsibility for correctly using) the hardware. On the other hand, FORTH is a difficult language for most people to learn. In addition, the Macintosh is a complicated piece of hardware and software that is difficult to learn and, in the learning phase, easy to "crash."

I strongly recommend that you consider these factors before buying MacFORTH. If you want to develop Macintosh software, MacFORTH is an alternative language to BASIC, Pascal, or 68000 assembly language that, once mastered, offers greater productivity and compactness of code than the

A Sample MacFORTH Program

The program shown here establishes three windows, titled Binary, Decimal, and Hex (see figure 1). Executing the FORTH words goto.binary , goto.decimal , and goto.hex transfers all keyboard I/O (input/ouput) to the appropriate window and changes the arithmetic computation base to base 2, 10, and 16, respectively. This program also creates a custom menu called Arith. Base , which lets you transfer control to the appropriate window by selecting a menu item. (The screen dump shows all three windows and the custom menu.)

The code in screen 18 creates the windows binary.win and hex.win . (The system window is renamed "Decimal" at the top of screen 19.) Note that a window is created in five lines and that the Binary window has a size box but that the Hex window doesn't (see figure 1 and listing 1, screen 18, lines 5 and 11). The windows can move over and under each other, and all but the Hex window can be changed to different sizes; all three windows can be closed by clicking the close box in the upper left-hand corner of the window.

Screens 19 and 20 define the three goto ... words. The last line of each definition (beginning with srccopy ...) is needed to change the window's output parameters to a mode and font appropriate to text display. (The default parameters are best for graphic output.) Note that the Hex window prints in a bold text style.

Screen 23 defines a pull-down menu and its behavior in 13 lines of code! Line 5 defines the menu title, and line 6 defines each menu selection; the "/D" after "Decimal" causes the Macintosh to recognize the cloverleaf-D keystroke as a substitute for the Decimal menu selection. Lines 9 through 13 define the behavior associated with each menu selection. Lines 3 through 13 define the word make.arith.menu ; line 15 executes that word and thereby creates the menu.

—*Gregg Williams*

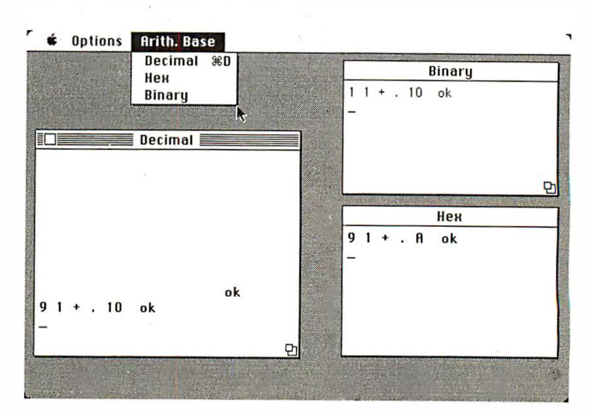


Figure 1: *Multiple windows and a custom menu. Notice that each box interprets numbers in a different way (the phrase* x y + . *adds two numbers and prints the sum). The three selections in the "Arith. Base" menu execute the words* goto.decimal , goto.hex , *and* goto.binary .

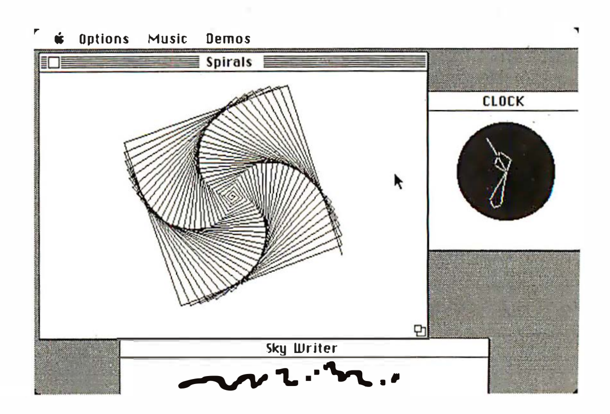


Figure 2: *Demo programs running in MacFORTH. Each window, when activated, runs a specific program. Spirals (currently active) draws different spiral patterns. Clock displays the time on a simulated analog watch face. Sky Writer lets you doodle in its window using the mouse cursor.*

Listing 1: A *sample* MacFORTH *program.*

```
SCR # 18          "FORTH Blocks 2"          06/11/84          10:30:27 AM
( sample windows program)                                    ( 061084 gw )
4 constant monaco                                           ( name typefont)

new.window binary.win                                       ( name window)
" Binary" binary.win w.title                                ( title window)
close.box size.box +        binary.win      w.attributes    ( give attbts)
45 300 150 150        binary.win      w.bounds   ( set position onscreen)
binary.win add.window                                       ( create window)

new.window hex.win
" Hex" hex.win w.title
close.box     hex.win     w.bounds
180 300 300 500     hex.win     w.bounds
hex.win add.window


SCR # 19          "FORTH Blocks 2"          06/11/84          10:30:34 AM
( sample windows program)                                    ( 061084 gw )

" Decimal" sys.window set.wtitle                   (rename default window)

: goto.hex     ( transfer to hex window, go to base 16 arith.)
     decimal     16 base !
     hex.win window
     srccopy textmode     monaco textfont     bold textstyle ;

: goto.binary                  ( transfer to binary window, base 2 arithmetic)
     DECIMAL     2 base !
     binary.win window
     srccopy textmode     monaco textfont     plain textstyle ;



SCR # 20          "FORTH Blocks 2"          06/11/84          10:30:39 AM
( sample program)                                            ( 061084 gw )

: goto.decimal              ( transfer to decimal window, base 10 arithmetic)
     decimal
     sys.window window
     srccopy textmode     monaco textfont     plain textstyle ;

.
.
.


SCR # 23          "FORTH Blocks 2"          06/11/84          10:48:29 AM
( menu sample)                                               ( 061184 gw )
4 constant base.menu        ( menu number of new menu)

: make.arith.menu
     base.menu delete.menu
     0 " Arith. Base" base.menu new.menu              ( specify menu title)
     " Decimal/D;Hex;Binary" base.menu append.items
          ( specify pull-down menu items)
     draw.menu.bar
     base.menu     menu.selection:     0 hilite.menu
     case     1 of     goto.decimal     endof          ( specify behavior of)
              2 of     goto.hex         endof          (   each menu item)
              3 of     goto.binary      endof
     endcase ;

make.arith.menu     ( create new menu)
```

others. (For software development, you will probably want to buy MacFORTH level 2 or 3; see text box.) MacFORTH level 1, the product reviewed here, will give the casual user more access to the system than other languages, but it will still require patience, experimentation, and study to be useful.

FORTH requires you to learn the function of many words that do one small task each. Unlike Pascal, which has a few dozen keywords, the average FORTH has well over a hundred. The glossary supplied with MacFORTH has 800 words, most of which deal with Macintosh-specific actions. You will need to know several hundred of them well; you should be aware of a few hundred more; as to the remainder, you may never figure out exactly what they do. The glossary in the back of the MacFORTH manual helps, as do the examples of FORTH code supplied with the system (which you should print out and study).

The people at Creative Solutions in Rockville, Maryland, creators of MacFORTH, are looking into creating a supplementary book about the Macintosh. Creative Solutions maintains a hotline, but calls are limited to questions simple enough to be answered in five minutes.

The documentation is better than most, but it is a tutorial on neither FORTH nor the Macintosh. I spent about 30 hours learning how to do simple window-based programs, and I crashed the system at least 40 times.

FORTH is very unforgiving of errors. I once crashed the system when I copied (or so I thought) the following word from the manual:

```
WINDOW
```

I should have typed

```
RESULTS WINDOW
```

which switched to a window named RESULTS. The omission of that one word caused MacFORTH to crash. (Version 1.1 is an improvement over version 1.0 in that some words that originally crashed when given too few arguments are now "trapped" and give an error message instead of crashing.) Using MacFORTH is like using a chain saw instead of an axe to cut wood—you can get more work done, but you'd better know what you're doing. ■

(continued from page A78)
to put in *two* serial ports, and of course that adds to the cost. Also, as we use more custom parts, get the manufacturing more automated, and lower our overhead in general, that'll bring the price down. Look at the trend of the IIe: we introduced the basic unit at $1395—that was with no disk drive, no anything. Now the same box with a disk driver and controller is going for $995.

BYTE: *There are a lot of parallel-oriented peripherals out there. How did the Apple designers decide to go with serial ports instead of parallel ports?*
Quinn: A number of reasons, not the least of which is the amount of space you need to bring out all the major signals for an 8-bit data bus—we didn't have a whole lot of space.

BYTE: *You mean you didn't have enough space on the rear panel.*
Quinn: Right—a parallel port would normally be as wide as a DB25 [connector]. The main thrust in our peripherals—the Imagewriter and our modem—is serial. So it fell out from there.

BYTE: *Another important connector on the rear panel is for [high-quality] RGB color.*
Quinn: Actually, it's called the video expansion port. All the major signals are brought out there, where hardware designers can get their mitts on them. In fact, we bring out sound here—when you connect a TV set through an RF modulator, you can go to the TV and turn the sound down. [Sound comes out of a small speaker beneath the keyboard on the Apple IIe and earlier computers and cannot be turned down.] So that was one feature we wanted. We knew we wanted RGB ultimately; we wanted a lot of video modes. With another box, we can convert the [American] NTSC [National Television Standard Committee] signal to PAL [Phase Alternate Live], the British standard.

And one of the guys at Apple, Rick Geiger, was saying that flat-panel technology was right around the corner. And we said, "Yeah, sure" [he laughs]. But we were smart enough to think that maybe we didn't know everything, so we bought out basically all varieties of video signals. And that allowed us to get the flat-panel capability when it came out—it came out a lot sooner than I thought.

I have a model here; we have five working prototypes, but I couldn't get one for today. The first one we got working, we made this cable that goes from here into a cigarette lighter. I took it out of the car and sat there and played Lode Runner. This is a state-of-the-art LCD [liquid-crystal display]—it's got 560 by 192 pixels, which will give you full double high-resolution pixels as well as the 80-column by 24-line display.

BYTE: *What are some of the ROM changes that were made to the IIc? I've heard that some bugs in the IIe ROM have been fixed, and there are 32 graphics characters.*
Quinn: The 32 graphics characters are what's called Mousetext. They are icons—hands, open and closed apples—embedded in the character set. They [software developers] were running into problems doing very fast, very quick word processors, for example, in high-resolution graphics. You're handling a chunk of data and scrolling becomes noticeably slow, but that's the only way you can get icons because your character set has nothing but ASCII characters.

The older Apple IIs have inverse and flashing characters in the character set. They [the Apple IIc design team] took some of these characters out and put in the icons. There are some plusses and minuses to doing that—it causes some incompatibilities with software already out. But the developers gave it an overwhelming "Please do it!"

BYTE: *What about Apple IIe bugs?*
Quinn: One of them doesn't affect the user, but it affects Apple. Do you know what "screen holes" are? [They are bytes within the text-page area of memory that do not show on the screen.] Obviously, we have those in our main 64K bank of memory, but you also have corresponding screen holes in both versions of the Apple IIe 80-column card. It turns out that if some Pascal routine looks at a certain screen hole and the firmware is pointing to its alternate—all this depends on how the RAM powered up, whether a certain location was 1 or 0—the computer would reset on scrolling. It turns out that the 64K[-bit] RAM chips [used on the extended 80-column card] come up in the right state. But the static RAMs for the regular 80-column card can come up either way—it depends on sunspots or what day of the week it is, I don't know. Anyway, we had to trash a certain percentage of our RAM chips [because of this].

There's some problem if you're using it [the Apple IIe] with a modem and [an Apple] Super Serial type [interface] card [running] at 1200 baud—I don't have the details.

BYTE: *Some problems with different kinds of modems or just one?*
Quinn: Basically, all kinds, I think. It actually worked, but you'd load your buffer and get garble on the screen. So it was loading in the text or whatever fine, but it would upset the user a bit.
[Editor's note: *Once the IIc had been out for a while, some users found that it worked with a modem at 300 bps but not at 1200 bps. Apple traced the problem to a hardware design flaw. According to Peter Quinn, new IIcs will have the flaw fixed and existing IIc owners can get both a software patch and a hardware modification from their dealers. . . .* G.W.]

BYTE: *Tell me something more about how you used the 65C02 to crunch the code down to a smaller size.*
Quinn: The 65C02 gives you 27 additional op codes. Not only were they able to write more crunched code for the peripheral-handling stuff, they also went back and crunched some of the existing video-handling routines. They were fixing bugs while they were at it. The developers can use this code, too, but they have to make a choice of whether or not they want to make their software backward compatible [with Apple II+ and IIe].

Later in the year or early next year, we'll probably offer an upgrade kit [with a 65C02 and a character generator ROM] that will fix the [IIe] bugs, but it will give you Mousetext. That causes some incompatibilities [with existing software].

BYTE: *I take it there have been no changes to the Applesoft ROM?*
Quinn: There have been. We decided to make lowercase [BASIC keywords] work.

BYTE: *Are you going to get any increased performance on Applesoft because of the 27 additional [65C02] op codes?*

Quinn: I didn't have the guts, when we brought out the IIe, even to touch that ROM space. But |with the IIc| I had the best three firmware writers in the world—Dick Huston, Ernie Beernink, and Rich Williams—working for me, and we made the choice |to add lowercase BASIC keywords|. But as far as going in and using different op codes, I wasn't that gutsy.

|Editor's note: *An interesting aside—the firmware writers embedded their names in the IIc. To see them, do an* IN#5, *then* INPUT A$, *then* PRINT A$. *Slot 5 has no use in a IIc, so the designers designed in a "ghost" peripheral that gives their names in a string as its input to the Apple. . . .* G.W.**|**

BYTE: *But there's a difference between, say, a speech-synthesis board, which needs a couple of bytes every few milliseconds, and a coprocessor board, which supposedly takes over the whole box. Wouldn't that be impossible for your serial port |on the IIc|?*

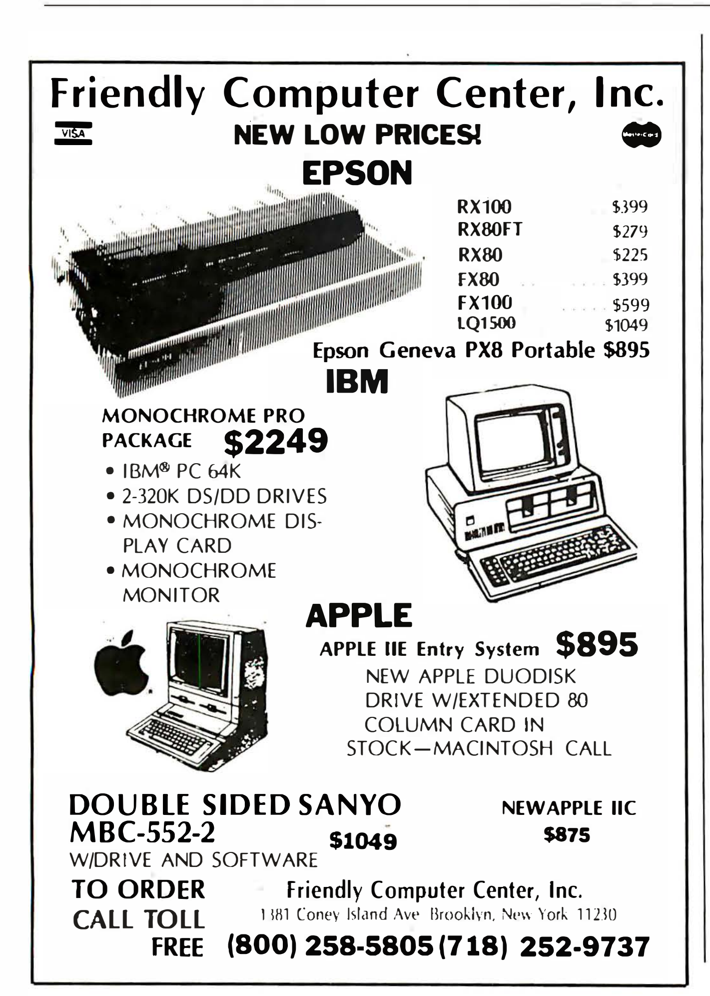
Quinn: Well, we don't have just the serial port; we also have the disk-drive port, which runs at more than 400K baud. Depending on how much intelligence you put on that outer box, nothing is impossible for an Apple II. Look at the Rana |8088 coprocessor| box—its coprocessor does MS-DOS and all that and hooks into an Apple II. Of course, it goes through the |peripheral| slot.

BYTE: *That's what I'm saying. Without slots |which the Apple IIc doesn't have|, how can you get the throughput you need for a coprocessor?*

Quinn: Several ways. One, you use a more or less high-level language |for| swapping between this processor and that processor. So the crunching happens over there and then comes back and is delivered through this I/O |the IIc serial ports|. You don't need that tremendous throughput. And there are other ways. Of course, these serial ports go up to 19,200 baud, and I believe with some tricks should do better than that. As you know, the Apple third-party developers are the first to find the tricks usually. So the door is not closed by any means.

BYTE: *I guess the only question to end with is a general one: where do you see the Apple II product family going?*

Quinn: Two years from now, you know the technology is going to progress even farther. Flat-panel displays will be a dime a dozen, VLSI will be more than feasible, so we'll be able to crunch more. So we'll do what we've always done in the past—take the same machine, maintain its greatness and its compatibility, and add value for the same price. Building in modems, building in RGB, you just take a shopping list and add to it. We may extend it lower—we're working on that. It depends on what makes sense—when you've got it breadboarded and wire-wrapped, does it look right? Does it feel right? Do you want one? We are unwilling to create anything we wouldn't want ourselves. ■



Circle 702 on inquiry card.



Circle 670 on inquiry card.

AT A GLANCE

Name
Premium Softcard IIe (for the Apple IIe only)

Version of CP/M
2.2

Manufacturer
Microsoft Corporation
Microsoft Building
10700 Northup Way
Bellevue, WA 98004
(206) 828-8080

Price
$395

Documentation
Osborne CP/M User Guide, installation and operations guide, and *Microsoft Basic Reference* manual

Features
Effective clock rate of 6 MHz; includes "standard set" of CP/M utilities, plus GBASIC (extra: if you return your warranty card, you will receive an assembly-language programmers manual); has 64K bytes of on-board RAM, which is available to Apple DOS and extends Apple IIe memory to 128K bytes for programs that are designed to use this added capacity; provides 80-column capacity

(continued from page A47)

The primary reason for this is that in order to be sure that the information in the disk cache is still accurate, the system must still briefly access the disk to make sure you have not changed the disk since the last time it was read. (Some systems have a way of sensing whether the user has opened the disk door; standard Apple disk units provide no such capability.)

CP/M CARD

If you purchase the ALS CP/M card and also the additional programmer's kit, you will have the same documentation that comes with the Gold Card. Additionally, the *Systems Guide* is supposed to contain a listing of the BIOS (basic input/output system) of the system.

Just a side note about CP/M 3.0 systems: the beginning user of CP/M would more likely make use of the installation guide and the *CBASIC Reference Manual*. The rest of the documentation, though, will be the most useful to the software developer or the hardware-system developer anxious to adapt his hardware to this new system.

APPLI-CARD

I was highly skeptical when I first received this card from Personal Computer Products Inc. (PCPI). My primary objection was the apparent lack of documentation with the unit. Still, I was able to run the applications programs I wanted. And the CP/M books could handle most of the rest of my requirements. (As mentioned before, MicroPro markets this card as StarCard.)

With the Appli-card, even though the standard CP/M commands (ED, STAT, PIP, etc.) are not explained in the manual, the programs that PCPI supplies are all well documented and menu-driven. One of the best features is a menu-driven install program that lets you make changes easily to the BIOS (similar to the so-called SYSGEN programs of the "old days" of CP/M).

One change I made in the system configuration was to install the RAMdisk software as drive A in the system. This was necessary to allow the maximum speed of a particular benchmark I was trying to put together.

The following information is provided separately from the benchmarks in the next section because none of the other cards tested had RAMdisk software available. (The Gold Card is specified for one of the comparisons—for the case in which its disk cache had an effect. For the other tests, all of the CP/M cards would have performed the same as the nonbanked version as indicated in the MBASIC read/write test.)

Table 1 shows the results of a "quickie" file copy test.

The file create and destroy test (see table 2) consisted of a sequence of 10 repeats of the commands:

```
SAVE 160 A40KFILE
ERA A40KFILE
```

in a file named TEST.SUB. This test file was run as a SUBMIT file from the RAMdisk in each case. To run it in the first case, both SUBMIT.COM and the command test file were on the RAMdisk, but the RAMdisk was not installed as the primary drive. The command was run by the sequence:

```
A>M:
M>SUBMIT TEST
```

In the second case, the RAMdisk was installed as the primary drive (A:) using the menu-driven install software. The timing difference came from the fact that CP/M 2.2 always writes a file named $$$.SUB onto the primary drive and steps back and forth between the directory and the file until the commands are all completed. The excess time shown in the table is due solely to the drive-access time.

Notice that the RAMdisk time of 0.86 seconds average for this operation is comparable to the result of 21 seconds for the original disk file copy (the RAMdisk created and destroyed a file 10 times in 8.6 seconds). This simply points out that there is some advantage to choosing the best way to use a RAMdisk when available.

As a final RAMdisk comparison, I switched over to the PCPI implementation of a RAMdisk under AppleDOS (see table 3). Only a very simple benchmark was tried: that of creating and saving a 31K-byte file (the limit of the BSAVE command). Here are the two commands I used:

```
BSAVE A31KFILE,A$400,L$7FFF
BLOAD A31KFILE
```

I used standard AppleDOS 3.3 (released in August 1980) for this test.

THE BENCHMARK TESTING

For benchmark testing, I used an Apple IIe as the host for all of the tests. Since the same program could be run, there would be no variation due to anything other than the processor card itself. I did not feel much would be gained by adding a disk-access benchmark to this test, since all of the processor add-on boards rely on the 6502 to do the disk access for them. With the exception of the Microsoft Premium Softcard IIe, which uses the auxiliary slot of the IIe, all were tested in slot 4.

The program was run, in all but one case, using Microsoft Softcard MBASIC. The program is a slightly modified version of the standard BYTE benchmark for the Eratosthenes Sieve prime-number program (see listing 1). It differs from the standard implementation only in the use of an integer variable (FL%) used as a replacement for a floating-point variable (FLAGS) throughout the program. I did this because some of the versions of the operating system did not allow enough free space to run the program as originally written. The free-space number reported by MBASIC is also shown in the performance chart.

For the tests using Microsoft Multiplan, I used the standard BYTE spreadsheet. This consists of a 25 by 25 matrix in which each cell differs from the cell to its immediate left by a factor of 1.001. Additionally, the leftmost cell of any row is 1.001 times the rightmost cell of the

(continued)

Table 1: *Results of the file copy test.*

	Time to Copy (seconds)	Notes
Gold Card (nonbanked)	21.0	
Gold Card (banked)	21.0	
	15.0	second-time copy (disk cache helps)
Appli-card (64K-byte)	21.0	
Appli-card (192K-byte)	21.0	disk to disk
	12.6	RAMdisk to disk
	9.5	disk to RAMdisk

Note: File created by the command: SAVE 160 A40KFILE; file copied by the command: PIP B: = A:A40KFILE

Table 2: *Results of the file create and destroy test performed 10 times.*

	Time to Copy (seconds)	Notes
Appli-card (192K bytes)	22.0	A: is Apple Disk and M: is RAMdisk
	8.6	A: is RAMdisk

Table 3: *Results of the file create and save test.*

	Time to Save (seconds)		Time to Load (seconds)
BSAVE to disk:	44.5	BLOAD from disk:	33.2
BSAVE to RAMdisk:	10.4	BLOAD from RAMdisk:	10.2

Note: RAMdisk free space under Apple FID is 731 sectors (187K bytes)

AT A GLANCE

Name
Gold Card

Version of CP/M
3.0

Manufacturer
Digital Research
POB 579
Pacific Grove, CA 93950
(408) 649-3896

Price
$775 (banked system—192K bytes on-board RAM), or $495 (nonbanked system—64K bytes)

Documentation
An installation guide, the Digital Research *CP/M Plus User's Guide*, the Digital Research *CBASIC Reference Manual*, DRI's *CP/M Plus Programmer's Guide*, DRI's *CP/M Plus Programmer's Utilities Guide*, DRI's *CP/M Plus Systems Guide*, and DRI's *SID Reference Guide*

Features
Effective clock rate of 6 MHz; comes with "standard set" of CP/M utilities including DIR, DIRSYS, ERASE, TYPE, USER, DATE, DEVICE, DUMP, ED, GET, HELP, INITDIR, PIP, SET, SETDEF, SHOW, and SUBMIT; also includes CBASIC (Digital Research version of BASIC) and several programming utilities including MAC, RMAC, HEXCOM, LINK, SID, and two kinds of cross-reference utilities (CBASIC and MAC files); has 80-column capability with the highest display update speed in the group tested (however, 80-column card is active only under CP/M); has 64K or 192K bytes in the banked version of on-board RAM; RAM is not available to Apple DOS

AT A GLANCE

Name
CP/M Card

Version of CP/M
3.0 (also known as CP/M Plus)

Manufacturer
Advanced Logic Systems
1195 East Arques Ave.
Sunnyvale, CA 94086
(408) 730-0306

Price
$399

Documentation
A 40-page *CP/M Card Users Guide*, the Digital Research's (DRI) *CP/M Plus Users Guide*, and DRI's *CBASIC Reference Manual*; available separately at extra cost of $79 are DRI's *CP/M Plus Programmer's Guide*, DRI's *CP/M Plus Programmer's Utilities Guide*, DRI's *CP/M Plus Systems Guide*, and DRI's *SID Reference Guide*

Features
Effective clock rate of 6 MHz; has 64K bytes of on-board RAM; "standard set" of CP/M 3.0 utilities; also includes CBASIC (Digital Research's version of BASIC) and several programming utilities including MAC, RMAC, HEXCOM, LINK, SID, and two kinds of cross-reference utilities (CBASIC and MAC files); does not have 80-column capability; does not have RAM available to Apple DOS

preceding row. There is only one independent cell in the entire matrix, at location 1,1. When its value changes, the whole spreadsheet must be recalculated. Except as noted in table 4, the 25 by 25 size was maintained.

OTHER BENCHMARKS

In addition to those shown in table 4, I ran the BYTE benchmarks for file creation and rereading. There was no discernible difference between any of the CP/M cards tested in this regard. Only the Digital Research Card was not tested in this manner due to BIOS interaction with the Softcard version of MBASIC. (Notice that this is not a problem; the standard CP/M version of MBASIC will run correctly with this card. It simply was not available for the review. Additionally, Digital Research does provide you with its own version, CBASIC.)

The results of the file create test are consistent at 69 seconds, while readback of the file created took 65 seconds. These figures can be used to compare the Apple, under CP/M 2.2 or 3.0, with other systems.

A listing of the programs as used with MBASIC is shown below:

File Create:

```
100  A$="12345678123456781
234567812345678"
120  B$=A$+A$+A$+A$
140  NR=512
160  OPEN "O",1,"B:TEST"
180  FOR I=1 TO NR
200  PRINT #1,B$
220  NEXT I
240  CLOSE
260  PRINT "DONE"
```

File Read:

```
300  NR=512
320  OPEN"I",1,"B:TEST"
340  FOR I=1 TO NR
360  INPUT#1,B$
380  NEXT I
400  CLOSE
420  PRINT "DONE"
```

The only surprise was that the Microsoft Softcard IIe performed exactly the same as the others. Because of the Multiplan results in the spreadsheet save section, I had expected that the results would be different. I have not yet discovered the reason for this seeming inconsistency.

CONCLUSIONS

You have many choices in expanding your Apple to add CP/M. Your decision should be based on support, cost, and speed.

The Apple slots have provided manufacturers the opportunity to offer a wide variety of products. Unfortunately, it is not always possible for products to talk to each other, or even to coexist. If the only kind of system you will ever have

Listing 1: *The BYTE Eratosthenes Sieve prime-number program (as modified by the author).*

```
800  SIZE = 7000
820  DIM FL%(7001)
830  PRINT"START ONE ITERATION"
840  COUNT = 0
850  FOR I = 1 TO SIZE
860  FL%(I) = 1
870  NEXT I
880  FOR I = 0 TO SIZE
890  IF FL%(I) = 0 THEN 970
900  PRIME = I + I + 3
910  K = I + PRIME
920  IF K > SIZE THEN 960
930  FL%(K) = 0
940  K = K + PRIME
950  GOTO 920
960  COUNT = COUNT + 1
970  NEXT I
980  PRINT "DONE: ";COUNT;" PRIMES FOUND"
990  END
```

AT A GLANCE

Name
Appli-Card (also known as the StarCard)

Version of CP/M
2.2

Manufacturer
Personal Computer Products
11590 West Bernardo Court
San Diego, CA 92127
(619) 485-8411

Price
6-MHz version, $395; 6-MHz version with RAMdisk (128K), $595; also available from MicroPro, packaged with WordStar or InfoStar, as the StarCard (a "free" accessory)

Documentation
A 60-page *Installation and User's Guide* and the *CP/M Primer*

Features
Effective clock rate of 6 MHz; comes with the "standard set" of CP/M utilities, the Apple DOS RAMdisk utility, a combined disk copy and format utility, and a program for transferring files from and to Apple DOS; in addition, an install program allows the installation of new device drivers into the system (device drivers are generally developed by the manufacturers of Apple peripherals and may be linked into this system using the install program); can provide a 70-column software-controlled display or a 40-column display with as many as 255 scrollable columns without installing an 80-column card if desired (however, functions normally with an 80-column card installed in the Apple); has 64K bytes of on-board RAM, plus either 64K or 128K-byte extender available; RAM is available to Apple DOS as a RAMdisk of 183K bytes under Apple DOS, as well as a 110K-byte RAMdisk under CP/M 2.2

is a standard Apple II product with a pair of floppy-disk drives, then any one of the CP/M cards will serve your purposes well. However, if you plan to expand your system in ways such as adding an 8-inch disk controller, a set of high-capacity 5¼-inch drives, a hard disk, or a RAMdisk of some kind, plan ahead!

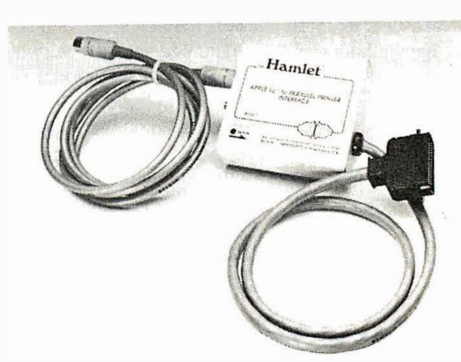
Ask the manufacturer of the peripheral you want to add which, if any, of the versions of CP/M can be adapted to the product.

For the older products, such as the Softcard and the Z-card, some manufacturers already have patches that allow their products to interface to CP/M

(continued)

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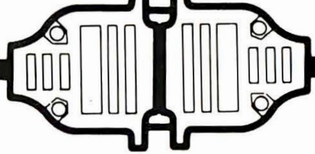
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Circle 665 on inquiry card.

Table 4: *Benchmark results using the Eratosthenes Sieve prime-number program.*

CP/M Card Type	"Bytes Free" reported by MBASIC	MBASIC Sieve	Multiplan Tests % Free	Load	Save	Recalc	Notes
Z-engine	26483	5:51	4	26	11	31.8	1,2
Softcard	26483	4:36	6	21.6	14.5	28.7	2
Softcard IIe	34675	2:04	53	12.7	4.5	9.6	2
			38	17.0	4.8	N/A	3
CP/M Card	35699	2:41	42	26.6	12.0	15.6	4
Appli-card	32883	1:53	31	18.7	11.7	13.3	4
Gold Card (nonbanked)	33651	1:54	6	16.5	10.7	9.3	2
Gold Card (banked)	26483	1:54	34	18.8	11.2	11.5	4,5
				6.8			6

Notes:

(1) This timing reflects the difference in bus access modification specified in the At a Glance box for this card. The times for the preceding version (Z-card II) were found to be identical to those of the Softcard. The version of MBASIC supplied with the Softcard is incompatible at the disk I/O level. I used the Microsoft Softcard boot disk instead of the ALS disk here since the hardware design is similar. Thus the benchmark could be run as stated, just to compare processing speed versus disk-access time.

(2) The standard BYTE benchmark for Multiplan calls for a 25-column by 25-row spreadsheet. Due to memory limitations, I was able to use only a 19-row by 25-column spreadsheet for those marked. The free space and timings reflect this reduced size.

(3) When I loaded the benchmark standard size spreadsheet, there was no problem. However, when I tried to perform a recalculate function on the 25 by 25 matrix, the system hung up after completing row 8. This may be due to some reaction between my version of Multiplan and the current BIOS of the Softcard IIe. I have Multiplan CP/M-80 version 1.05 and Softcard IIe BIOS verison 2.2.6. The problem has been reported to Microsoft. Since I couldn't do a 25 by 25, I dropped back to the smaller 19-row by 25-column sheet. Since this is still a significant overall size, I don't consider this a major problem. (Since I ran these tests, Microsoft has assured me that its version 1.06 of Multiplan does not exhibit this problem.)

(4) Standard sized spreadsheet (25 by 25 cells).

(5) Again a difference in the BIOS prevented disk I/O under MBASIC. Because the hardware design did not allow a boot of an alternate system, the disk file create/reread under MBASIC was not performed for the Gold card.

(6) This reflects a second load of the same spreadsheet. CP/M 3.0 performs "disk cache" operations. If it knows it has either read or written certain tracks before and that they have not been changed since, then the data comes from the disk-cache (high-speed RAM) instead of the disk.

The flexibility of manufacturers to allow multiple nonrelated products is limited by two factors: economy and space.

properly. However, it has been my experience that if I have a hard-disk drive and an 8-inch disk drive coresident in the system, I must boot each manufacturer's version of CP/M separately and transfer data between the drives using the 5¼-inch floppy disks. The flexibility of the manufacturers to allow multiple nonrelated products is limited by two factors: economy and space incentives.

Very few people have unusual combinations of cards in their systems, and manufacturers must dedicate their time and resources to whatever will pay them best. And in the bus-sharing approach, if you want to keep a 56K-byte TPA (transient program area) for the Z80, not much room is left to define many different kinds of I/O devices to which the 6502 can talk.

Again, these older cards are perfectly acceptable if you know what your applications will be and what your system will contain.

For the Future

The Apple CP/M user has hope for future device compatibility through the adaptable systems as used in the Appli-card and the CP/M Plus/CP/M 3.0 offerings (Gold Card and CP/M Card). Because the coprocessor approach is used, a lot more room is left in the 6502 program space, where device drivers can be created and linked together. This still leaves a large enough area for the transient programs.

These CP/M boards offer an adaptable BIOS, which enables you to add and modify device drivers.

If you need modem software, I recommend that you ask the CP/M manufacturer for specific recommendations or help in getting on line. My primary gripe is that none of them offers any form of communications software of the MODEM7-compatible sort in the box with the unit.

A Final Note

Once you have purchased a CP/M card, I recommend that you join a CP/M user's group. Take advantage of some of the "freeware" (free software) available to the user community. Some of it is good, some bad, some just fun. People out there are often just waiting to help you through your problems. ■

(continued from page A29)

Listing 3: *The Shiftline routine. This 6502 assembly-language routine shifts one line of a video image as described in figure 7. We used the Apple DOS Tool Kit assembler to create the object-code file, which is named* SHIFTLINE ROUTINE.OBJ0.

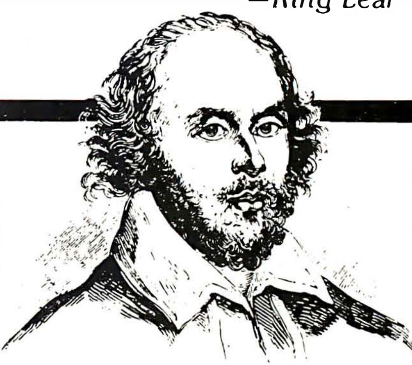
```
SOURCE FILE: SHIFTLINE ROUTINE
------- NEXT OBJECT FILE NAME IS SHIFTLINE ROUTINE.OBJ0
5210:              ORG   $5210
5210:           ;
5210:           ;                  PRESHIFT GRAPHICS ROUTINE
5210:           ;                  BY ROB MOORE & BILL BUDGE
5210:           ;

5210:           ;
0040:           BASE1    EQU   $40         ; BASE PAGE ROW ADDR POINTER
5210:           ;
5210:           ; LOOKUP TABLES
5210:           ;
4000:           SHFTSTAY EQU   $4000       ; SHIFTOUT TABLES
4700:           SHIFTOUT EQU   $4700       ; SHIFT TABLES
4E00:           XDIV7    EQU   $4E00       ; INDEX DIV 7
4F00:           XMOD7    EQU   $4F00       ; INDEX MOD 7
5000:           ROWTBL   EQU   $5000       ; SCREEN ROW ADDR LO-BYTES
50C0:           ROWTBH   EDU   $50C0       ; SCREEN ROW ADDR HI-BYTES
5210:           ;
5210:           ; IMAGE DEFINITION PARAMETERS — SET BY USER
5210:           ;
5210:           IROWS    EQU   $5200       ; # OF ROWS — 1
5210:           IDOTS    EQU   $5201       ; DOT WIDTH -1
5202:           IBWIDTH  EQU   $5202       ; IMAGE BYTE WIDTH
5203:           IBITS    EQU   $5203       ; ADDR OF IMAGE DATA
5205:           X1       EQU   $5205       ; IMAGE LEFT X-COORD
5206:           Y1       EQU   $5206       ; IMAGE TOP Y-COORD
5210:           ;
5210:           ;
5210:           ; FIRST, SET UP THE VARIOUS PARAMETERS TO PREPARE
5210:           ; FOR THE IMAGE DRAW.
5210:           ;
5210:8E E9 52   DRAWIMAGE STX  XSAVE       ; SAVE BASIC X-REG
5213:AD 06 52            LDA   Y1          ; IMAGE TOP ROW #
5216:18                  CLC
5217:6D 00 52            ADC   IROWS       ;  + # OF ROWS -1
521A:8D E1 52            STA   Y2          ;  = BOTTOM ROW #
521D:           ;
521D:AE 05 52            LDX   X1          ; IMAGE LEFT X-COORD
5220:BD 00 4E            LDA   XDIV7,X     ;  DIVIDED BY 7
5223:8D E2 52            STA   LBYTE       ;  = IMAGE LEFT BYTE #
5226:           ;
5226:BC 00 4F            LDY   XMOD7,X     ; IMAGE LEFT BIT #
5229:B9 DA 52            LDA   LMASKS,Y    ; INDEXES LMASK TABLE FOR
522C:8D E3 52            STA   LMASK       ; IMAGE LEFT BIT MASK
522F:           ;
522F:98                  TYA               ; IMAGE LEFT BIT #
5230:18                  CLC               ; + SHIFT TABLES ADDRESS
5231:69 40               ADC   #<SHFTSTAY  ; * 256
5233:8D 8A 52            STA   PATCH3      ; TO SHIFT PATCH
5236:           ;
5236:69 07               ADC   #7          ; OFFSET TO SHIFTOUT TABLES
5238:8D 84 52            STA   PATCH2      ; SETS UP SHIFTOUT PATCH
523B:           ;
523B:98                  TYA               ; IMAGE LEFT BIT #
523C:18                  CLC
523D:6D 01 52            ADC   IDOTS       ;  + IMAGE DOT WIDTH
5240:AA                  TAX
5241:BD 00 4E            LDA   XDIV7,X     ;  DIVIDED BY 7
5244:8D E5 52            STA   SBWIDTH     ;  = SHIFTED DATA BYTE WIDTH
5247:           ;
5247:BC 00 4F            LDY   XMOD7,X     ; RIGHT EDGE BIT #
```

(continued)

Circle 701 on inquiry card.

At Christmas I no more desire a rose
Than wish a snow in May's new fangled mirth
But like of each thing that in season grows
—King Lear



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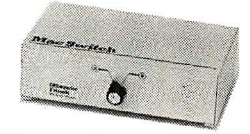
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Circle 671 on inquiry card.

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TELEMAX, INC.
Computer & Video Products
P.O. Box 339 ● Warrington, PA 18976
(215) 343-3000

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Circle 698 on inquiry card.


```
524A:B9 D3 52             LDA   RMASKS,Y     ; INDEX RMASKS TABLE FOR
524D:8D E4 52             STA   RMASK        ; IMAGE RIGHT BIT MASK.
5250:               ;
5250:AC 02 52             LDY   IBWIDTH      ; IMAGE WIDTH IN BYTES
5253:8C E6 52             STY   PITCH        ; IS BITMAP PITCH
5256:88                   DEY                ; SUBTRACT 1 TO GET
5257:8C E7 52             STY   SHFTINDX     ; SHIFT START INDEX
525A:               ;
525A:AD 03 52             LDA   IBITS        ; COPY IMAGE DATA ADDRESS
525D:8D 80 52             STA   PATCH1       ; TO SHIFT ROUTINE PATCH1
5260:AD 04 52             LDA   IBITS+1
5263:8D 81 52             STA   PATCH1+1
5266:               ;
5266:               ; MAIN DRAW LOOP STARTS HERE
5266:               ;
5266:AE 06 52             LDX   Y1           ; IMAGE TOP SCRN ROW #
5269:BD 00 50       DRAW  LDA   ROWTBL,X     ; SCREEN ROW ADDR LO-BYTE
526C:18                   CLC
526D:6D E2 52             ADC   LBYTE        ; + LEFT IMAGE BYTE #
5270:85 40                STA   BASE1        ; TO SCRN ADDR POINTER
5272:BD C0 50             LDA   ROWTBH,X     ; SCREEN ROW ADDR HI-BYTE
5275:85 41                STA   BASE1+1      ; TO POINTER HI-BYTE
5277:8E E8 52             STX   TEMP         ; SAVE CURRENT ROW #
527A:               ;
527A:               ; BILL BUDGE'S SHIFT CODE STARTS HERE.
527A:               ; IT SHIFTS A ROW OF STORED BITMAP DATA INTO A
527A:               ; SINGLE-LINE BUFFER, WHICH CAN THEN BE DRAWN TO
527A:               ;         THE SCREEN
527A:               ;
527A:A9 00                LDA   #0           ; SETUP FOR SHIFTING
527C:AC E7 52             LDY   SHFTINDX
527F:               ;
5280:               PATCH1 EQU  *+1
527F:BE FF FF       SHIFTIT LDX $FFFF,Y      ; GET A BYTE OF IMAGE DATA
5284:               PATCH2 EQU  *+2
5282:1D 00 47       ORA   SHIFTOUT,X         ; LOOK UP SHIFTED OUT PART
5285:99 EB 52       STA   BUFFER+1,Y         ; AND STORE IN BUFFER
528A:               PATCH3 EQU  *+2
5288:BD 00 40             LDA   SHFTSTAY,X   ; LOAD THE SHIFTED PART
528B:88                   DEY   ; DONE WITH ROW YET?
528C:10 F1                BPL   SHIFTIT      ; LOOP BACK IF NOT
528E:8D EA 52             STA   BUFFER       ; STORE LAST SHIFTED PART
5291:               ;
5291:               ; ACTUAL DRAW CODE STARTS HERE. NOTE THAT THE
5291:               ; RIGHTHAND AND LEFTHAND EDGE BYTES ARE TREATED
5291:               ; DIFFERENTLY BECAUSE THEY MAY BE PARTIAL-BYTE
5291:               ; WRITE OPERATIONS.
5291:               ;
5291:AC E5 52             LDY   SBWIDTH      ; SHIFTED DATA BYTE WIDTH
5294:AE E8 52             LDX   TEMP         ; GET BACK THE ROW #
5297:               ;
5297:               ; DO THE RIGHTHAND IMAGE BYTE
5297:               ;
5297:B1 40                LDA   (BASE1),Y    ; GET A SCREEN BYTE
5299:59 EA 52             EOR   BUFFER,Y     ; XOR WITH IMAGE DATA
529C:2D E4 52             AND   RMASK        ; MASK UNWRITTEN AREA
529F:51 40                EOR   (BASE1),Y    ; RESTORE SCRN AND IMAGE
52A1:4C A7 52             JMP   DRAW2
52A4:               ;
52A4:               ; FAST LOOP TO DRAW IN-BETWEEN BYTES
52A4:               ;
52A4:B9 EA 52       DRAW1 LDA   BUFFER,Y     ; GET AN IMAGE BYTE
52A7:91 40          DRAW2 STA   (BASE1),Y    ; WRITE BYTE TO SCREEN
52A9:88                   DEY                ; DECREMENT COUNT
52AA:D0 F8                BNE   DRAW1        ; LOOP BACK IF NOT DONE
52AC:               ;
52AC:               ; FINISH UP WITH LEFTHAND BYTE
52AC:               ;
52AC:B1 40          DRAW3 LDA   (BASE1),Y    ; GET A SCREEN BYTE
52AE:59 EA 52             EOR   BUFFER,Y     ; XOR WITH IMAGE BYTE
52B1:2D E3 52             AND   LMASK        ; MASK UNWANTED PART
```

(continued)

```
52B4:51 40          EOR  (BASE1),Y      ; RESTORE SCRN AND IMAGE
52B6:91 40          STA  (BASE1),Y      ; AND WRITE TO SCREEN
52B8:        ;
52B8:        ; TEST FOR LAST ROW COMPLETE
52B8:        ;
52B8:EC E1 52       CPX  Y2             ; WAS LAST ROW DONE
52BB:F0 12          BEQ  EXIT           ; QUIT IF SO.
52BD:        ;
52BD:E8             INX                 ; MOVE TO NEXT ROW
52BE:18             CLC                 ; ADD THE BITMAP PITCH
52BF:AD 80 52       LDA  PATCH1         ; TO THE SHIFT ROUTINE
52C2:6D E6 52       ADC  PITCH          ; POINTER TO MOVE TO
52C5:8D 80 52       STA  PATCH1         ; THE NEXT BITMAP ROW.
52C8:90 9F          BCC  DRAW           ; LOOP AGAIN IF NO CARRY
52CA:EE 81 52       INC  PATCH1$1
52CD:B0 9A          BCS  DRAW           ; LOOP AGAIN, ALWAYS
52CF:AE E9 52  EXIT LDX  XSAVE
52D2:60             RTS                 ; EXIT HERE
52D3:        ;
52D3:        ; RIGHT AND LEFT BIT-MASKS TABLES
52D3:        ;
52D3:01 03 07  RMASKS DFB  $01,$03,$07,$0F,$1F,$3F,$7F
52D6:0F 1F 3F
52D9:7F
52DA:7F 7E 7C  LMASKS DFB  $7F,$7E,$7C,$78,$70,$60,$40
52DD:78 70 50
52E0:40
52E1:        ;
52E1:        ; PROGRAM VARIABLES
52E1:        ;
52E1:00        Y2       DFB  0          ; BOTTOM Y-COORD
52E2:00        LBYTE    DFB  0          ; LEFT BYTE #
52E3:00        LMASK    DFB  0          ; LEFT BIT MASK
52E4:00        RMASK    DFB  0          ; RIGHT BIT MASK
52E5:00        SBWIDTH  DFB  0          ; SHIFTED IMAGE BYTE WIDTH
52E6:00        PITCH    DFB  0          ; BITMAP ROW PITCH
52E7:00        SHFTINDX DFB  0          ; BITMAP WIDTH
52E8:00        TEMP     DFB  0          ; TEMP STORAGE
52E9:00        XSAVE    DFB  0          ; FOR SAVED X-REG
52EA:          BUFFER   DS   40,0       ; SHIFTED DATA ROW BUFFER

*** SUCCESSFUL ASSEMBLY: NO ERRORS
```

Listing 4: *The* DIV7 *program creates two 256-byte tables that contain the integer quotient and remainder of the value* n/7, *respectively, for* n=0 *to* 255. *The resulting table is saved as* DIV7 TABLE.

```
]LIST

100 REM
110 REM  DIVIDE-BY-7 QUOTIENT
120 REM  AND REMAINDER TABLES
130 REM
140 REM  BY GREGG WILLIAMS,
150 REM  24 APR 84
160 REM
200 QUOTBGN = 16384
210 REM --POINTS TO MEMORY AREA
220 REM --USED TO STORE TABLE
230 REM
240 RMDRBGN = QUOTBGN + 256
250 HOME : PRINT "CREATING DIV7 TABLE..."
300 FOR I = 0 TO 255
310 :QVL = INT (I / 7)
320 :RVL = I - QVL * 7
330 : POKE QUOTBGN + I,QVL
340 : POKE RMDRBGN + I,RVL
350 NEXT I
400 PRINT CHR$ (4);"BSAVE DIV7 TABLE,A";QUOTBGN;",L512"
420 PRINT : PRINT "TABLE SAVED TO DISK"
500 END
```

(continued)

LISA

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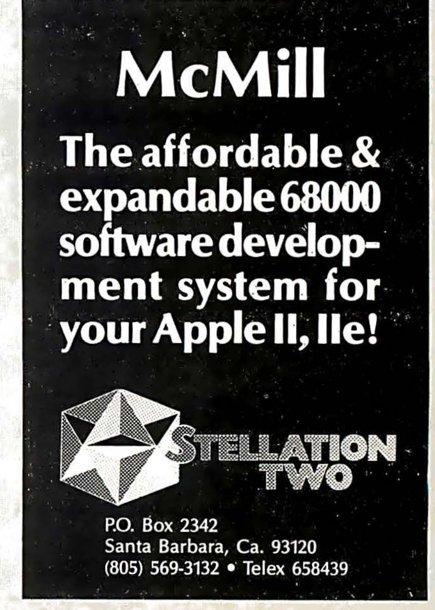
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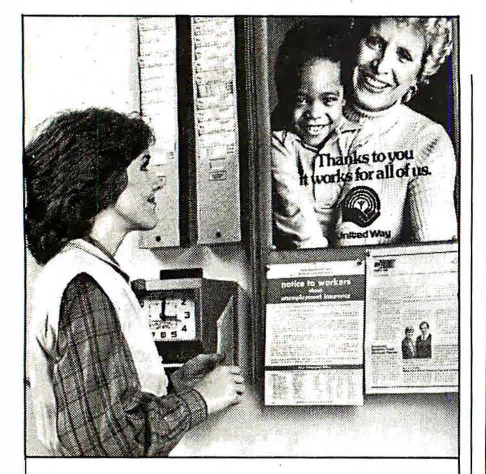
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Listing 5: *The Consolidate program loads the tables created by listings 1, 2, and 4, adds an image table, and stores the composite table in the file* TABLPAK *for later use.*

```
100 REM
110 REM  CONSOLIDATE-
120 REM  TABLES PROGRAM
130 REM
140 REM  BY GREGG WILLIAMS
150 REM  23 APR 84
160 REM
170 REM  ----------------------------------------------------
180 REM
190 HOME : PRINT "CREATING TABLPAK...."
200 TBLSIZ = 32
236 REM
240 D$ = CHR$ (4)
250 PRINT D$;"BLOAD PRESHIFT TABLE,A$4000"
260 PRINT D$;"BLOAD DIV7 TABLE,A$4E00"
270 PRINT D$;"BLOAD HIRES1 TABLE,DA$5000"
280 REM
290 REM --LOAD NEEDED TABLES
300 REM --INTO MEMORY
320 REM
330 REM
540 REM
550 QQ$ = "5180:0D 0D 02 00 00 00 00 7C 0F 7C 07 7C 03 7C 01 7C
    03 7C 07 5C 0F 0C 1F 04 0E 00 04 00 00 00 00"
560 GOSUB 63000
570 REM --PUT IMAGE INTO MEMORY
580 REM --USING MONITOR COMMANDS
590 REM
600 REM
610 PRINT D$;"BSAVE TABLPAK,A$4000,L";4480 + TBLSIZ
615 PRINT : PRINT "FILE SAVED TO DISK"
620 REM
630 END
640 REM
62975 REM  ---------------------------------------------------
62980 REM
62985 REM --FAMOUS S. H. LAM
62990 REM --MONITOR ROUTINE FOR
62993 REM --EXECUTING MONITOR
62995 REM --COMMANDS FROM BASIC
62997 REM
63000 QQ$ = QQ$ + " ND9C6G"
63010 FOR QQ = 1 TO LEN (QQ$): POKE 511 + QQ,128 + ASC
      ( MID$ (QQ$,QQ,1)): NEXT
63020 POKE 72,0: CALL - 144
63030 RETURN
```

Table 1: *Format for the image table. The BASIC demonstration program of listing 6 expects an image table in the format given by this table. Listing 3 expects this table at location 5180 hexadecimal (20864 decimal), but this can be easily changed by changing the value stored at IBits (location 5203 hexadecimal).*

Byte	Contents
0	(number of rows in image) — 1
1	(number of dots in row) — 1
2	number of bytes in one row of image
3, 4, 5...	successive bytes of image, starting with upper-left corner and proceeding by rows

Listing 6: *A program that demonstrates the preshift-table lookup method. This program uses joystick or paddle input to guide an arrow image across the high-resolution graphics screen. See text for details.*

```
]LIST

100 REM
110 REM  BUDGE PRESHIFT
120 REM  GRAPHICS DEMO
130 REM
140 REM  BY BILL BUDGE,
150 REM  GREGG WILLIAMS,
160 REM  AND ROB MOORE
170 REM
180 REM  --------------------------------------------------
190 REM
200 REM  INITIALIZATION
210 REM
220 GOSUB 3000
230 REM --LOAD FILES (NEEDS
240 REM --TO BE DONE ONLY ONCE)
250 REM
260 GOSUB 2000
270 REM --INITIALIZE TABLES
280 REM
480 REM
490 REM  --------------------------------------------------
500 REM
510 REM  MAIN LOOP
520 REM
530 REM  IFPEEK ( - 16287) > 127 THEN
    820
535 REM --WHILE LOOP: LOOP
540 REM --WHILE BUTTON 0
550 REM --NOT PRESSED
560 REM
570 XVLUE = PDL (0)
580 YVLUE = PDL (1)
590 REM --GET JOYSTICK OR
600 REM --PADDLE VALUES
610 REM
620 XINCR = - 1 * DOTSMOVE * (XVLUE < C1THRLO) + DOTS
    MOVE * (XVLUE > C2THRHI)
630 YINCR = - 1 * DOTSMOVE * (YVLUE < C1THRLO) + DOTS
    MOVE * (YVLUE > C2THRHI)
640 REM --CONVERT JOYSTICK
650 REM --INPUT TO -1,0, OR 1
660 REM
670 IF (XPSN + XINCR) > = C3XMIN AND (XPSN + XINCR) < =
    C4XMAX THEN XPSN = XPSN + XINCR
680 IF (YPSN + YINCR) > = C5YMIN AND (YPSN + YINCR) < =
    C6YMAX THEN YPSN = YPSN + YINCR
690 REM --MODIFY X, Y POSITIONS
700 REM --IF WITHIN BOUNDS
703 REM
706 POKE X1,XPSN
708 POKE Y1,YPSN
710 REM --POKE X & Y COORDS
712 REM --OF IMAGE INTO
714 REM --BYTES USED BY THE
716 REM --CODE SUBROUTINE
718 REM
720 CALL CODEADDR
730 REM --CALL MACHINE-LANG.
740 REM --BLOCK-MOVE ROUTINE
750 REM
760 GOTO 530
770 REM --END OF WHILE LOOP
780 REM
790 REM  --------------------------------------------------
800 REM
810 END
820 REM --END OF PGM
830 REM
1940 REM
1950 REM
1960 REM  --------------------------------------------------
1970 REM
1980 REM INITIALIZATION
1985 REM SUBROUTINE
1990 REM
2000 DOTSMOVE = 2
2010 REM --MAXIMUM INCREMENT
2020 REM --OF IMAGE
2030 REM
2040 XPSN = 100:YPSN = 100
2050 REM --POSITION OF IMAGE
2060 REM
2070 C1THRLO = 100:C2THRHI = 150
2080 REM --THRESHOLD VALUES
2090 REM --FOR JOYSTICK INPUT
2100 REM
2110 C3XMIN = 5:C4XMAX = 235
2120 C5YMIN = 5:C6YMAX = 175
2130 REM --BOUNDARIES OF IMAGE
2140 REM --MOVEMENT ON SCREEN
2150 REM
2160 CODEADDR = 21008
2170 REM --ADDRESS OF MACHINE-
2180 REM --LANGUAGE SUBROUTINE
2190 REM
2200 IROWS = 20992
2210 IDOTS = IROWS + 1
2220 IWIDTH = IROWS + 2
2230 IBITS = IROWS + 3
2240 X1 = IROWS + 5
2250 Y1 = IROWS + 6
2260 REM --ADDRESSES OF DATA
2270 REM --NEEDED BY ASSBY-
2280 REM --LANGUAGE ROUTINE
2290 REM
2420 POKE IROWS, PEEK (IMAGTBL)
2430 POKE IDOTS, PEEK (IMAGTBL + 1)
2440 POKE IWIDTH, PEEK (IMAGTBL + 2)
2450 IP = IMAGTBL + 3
2460 C8IPLO = INT (IP / 256)
2470 C7IPHI = IP - 256 * C8IPLO
2480 POKE IBITS,C7IPLO
2490 POKE IBITS + 1,C8IPHI
2500 REM --SETUP VALUES NEEDED
2510 REM --BY ASSEMBLY-LANGUAGE
2520 REM --ROUTINE
2530 REM
2540 HGR : POKE - 16302,0
2550 REM --SWITCH TO HIRES PG1
2560 REM
2570 RETURN
2930 REM
2935 REM  --------------------------------------------------
2940 REM
2950 REM LOAD FILES
2960 REM SUBROUTINE
2970 REM
3000 IMAGTBL = 20864
3010 REM --ADDRESS OF TABLE
3020 REM --CONTAINING IMAGE
3030 REM --TO BE MOVED
3040 REM
3050 D$ = CHR$ (4)
3060 PRINT D$;"BLOAD QD.DEMO.0"
3070 PRINT D$;"BLOAD TABLPAK,A$4000"
3080 PRINT D$;"BLOAD IMAGE,A";IMAGTBL
3090 REM --LOAD ASSBY-LANGUAGE
3100 REM --ROUTINE AND TABLES
3110 REM
3120 RETURN
```

(continued from page A27)

assembly-language routine of listing 3; it then uses joystick (or paddle) input to move the image around the high-resolution graphics screen. This program uses an image that has two rows of unlighted dots on every edge (it is a 10 by 10 image centered in a 14 by 14 box). Because the program moves the image only two dots at a time, the arrow image erases itself as it moves and leaves no trail.

This program, like the others, was written with simplicity and clarity in mind rather than speed or program features. The fact that the program moves the arrow slowly across the screen is the fault of BASIC, not the assembly-language program. To make this demo run faster, you can "tighten up" the main loop in lines 530–760 or incorporate some of the joystick decoding and boundary checking in another assembly-language program that, in turn, calls listing 3.

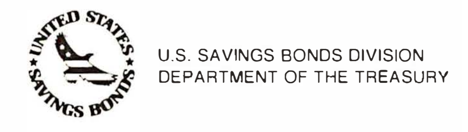
The preshift-table lookup method is a compromise between utility and ease of comprehension. Although this technique is not as fast as the preshifted-shapes method often used for animation, it is a general-purpose method that will probably find a number of uses. ■

Figure 7: *Moving a rectangular image. In the example subroutine of listing 3, the routine takes the image a line at a time, uses the preshift table to shift it, puts it in a single-line buffer, then transfers it to the high-resolution screen. This is only one possible subroutine that implements the routine in figure 6.*

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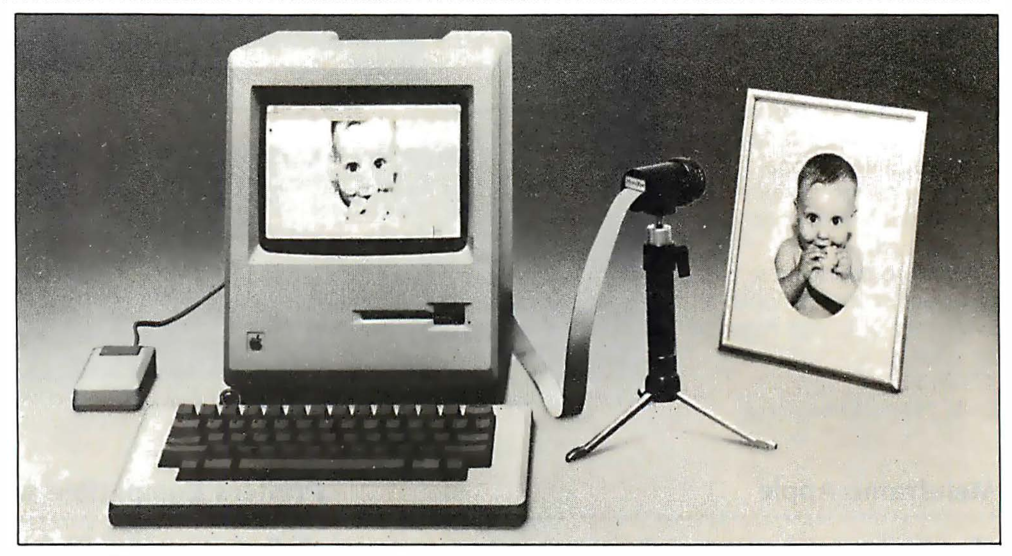
The Photographic Mac

An image reader that enables the Macintosh to produce a digital image of a photograph or object, MicronEye comes with a lens, tripod, software, and users guide. You can print a picture or save it to disk. The results are compatible with MacPaint.

The MicronEye uses pull-down menus, and its software contains several built-in image enhancers.

The MicronEye is available for $395 from Micron Technology Inc., Vision Systems Group, 2805 E. Columbia Rd., Boise, ID 83706, (208) 383-4106.

Circle **772** on inquiry card.



MicronEye enables the Mac to read photographs.

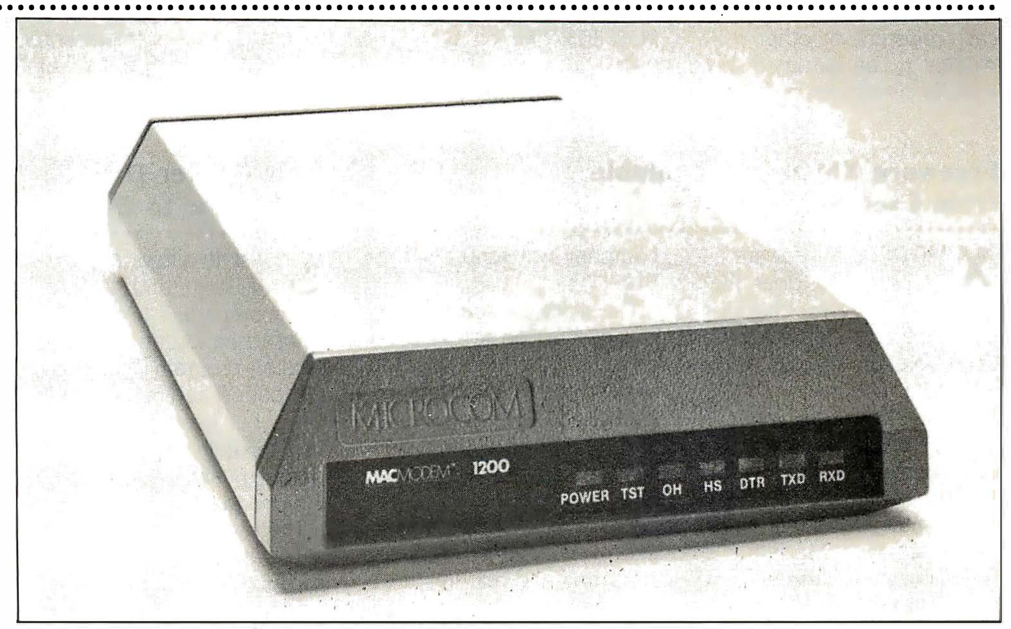
New Auto-Dial Modem for Mac

MacModem from Microcom is a 300- to 1200-bps auto-dial and auto-answer modem for the Macintosh. If you need to operate at a higher level, the MacModem can be upgraded to 2400 bps.

The Microcom modem will transfer files between two Macs or a Mac and an IBM PC, PCjr, Apple IIe, or Apple III. The MacModem offers both tone and pulse dialing and call progress monitoring.

The MacModem uses the "point and click" mouse technology. You can store phone numbers, communications parameters, and log-on sequences.

MacModem also supports Microcom's Networking Protocol. MNP finds and corrects line noises before data is sent to the display or stored on disk.



Microcom's new modem can be upgraded to 2400 bps.

MacModem and its communications software are available from Microcom Inc., 1400A Providence Highway, Norwood, MA 02062, (617) 762-9310.

Circle **771** on inquiry card.

(continued)

All products mentioned in this section are described by manufacturers' specifications, and their publication in BYTE *does not constitute an endorsement.*

High-Speed Dot Matrix

Comriter 420 boasts 420 characters per second in draft mode and 104 characters per second in correspondence-quality mode.

The newest Epson dot-matrix printer features an 18K-byte buffer and a built-in panel of control keys that lets you choose type styles and form length.

Equipped with selectable serial or parallel interfaces and eight international language fonts, the Comrite 420 comes with friction or tractor feed.

For more information, contact Comrex International, a subsidiary of Epson America Inc., Torrance, CA (213) 373-0280.

Circle **795** on inquiry card.



The ComRiter 420 dot-matrix printer features an 18K-byte buffer.

Mainframe Apple

Apple-Bisync, a hardware/software system, turns the Apple II or IIe into a remote terminal for IBM mainframes. It can also connect Apples to scanners, cash registers, or other Apples. It can automatically transfer a number of files to mainframes and can save files from mainframes on disk.

Apple-Bisync costs $750.

For more information, contact Urgeo Software Inc., POB 305, Cheney, WA 99004, (509) 838-6058.

Circle **789** on inquiry card.

Printers Compatible with Mac

Microline 92 and 93 dot-matrix printers are now compatible with the Apple family of computers, including Macintosh and Lisa. The ML 92 and 93 emulate Apple's Imagewriter, allowing you to print graphics screens. They also allow correspondence-quality printing from the Apple IIe and II+.

The printers are available through authorized Okidata dealers, 532 Fellowship Rd., Mt. Laurel, NJ 08054, (609) 235-2600.

Circle **796** on inquiry card.

Freeware XMODEM Available from Exec Software

XMODEM, a freeware program that does file transfers with error-checking protocol, is available from Exec Software for the Apple II and IIe.

XMODEM will let you transfer BASIC and binary code between Apples without translating the files to text format. Users will need the Hayes MicroModem.

The program can be downloaded from Exec Software Customer Support Bulletin Board at (617) 863-0282. The company asks that people who find the program useful send $15 to the programmer. The company will send disks for $10.

The price for the freeware can be applied to the purchase of TermExec, an auto-answer communications package for the Apple II, IIe, and II+, which allows you to catalog, copy, delete and rename.

The latest version, TermExec 1.2, works at up to 1200 bps and features an improved screen editor. It includes the freeware and costs $79.95.

Write Exec Software, 201 Waltham St., Lexington, MA 02173 or call (617) 862-3170.

Circle **777** on inquiry card.

New Printer Driver Links Mac to Epson

Softstyle allows MacWrite, MacPaint, and all Macintosh-compatible programs to print to an Epson. The conversion program needs to be loaded and run only once, but users can reconvert to their original printer driver by executing a few commands.

The program requires a cable and a serial interface card for the Epson FX-80, sold separately from a variety of manufacturers.

Softstyle costs $29.95 and is available from Softstyle, a Honolulu company, or through any Epson dealer.

Circle **776** on inquiry card.

Adds Printers to your Mac

The Printer Optimizer is a 64K- to 256K-byte spooler that allows you to use your Mac while printing. At the same time, the spooler can accommodate as many as three printers or plotters. The peripherals can be a mix of serial or parallel devices. The Printer Optimizer has three ports: two RS-232C serial ports and a Centronics parallel port.

Printer Optimizer is from Applied Creative Technology Inc., 2156 W. Northwest Highway, Suite 303, Dallas, TX 75220, (800) 433-5373, in Texas (214) 556-2916.

Circle **773** on inquiry card.

Apple Music Board

The Digital Sound Sampling Sequencer (DS3) imported from England is available as an add-on board to the Apple II and IIe. The 64K bytes of memory on an Apple yield approximately 2½ seconds of sample time at a rate of 30 kHz. You can create any percussive sound, and complete concerts can be stored to Apple disks. You can enter sequences from the keyboard or from a digitally scanned music keyboard. Four-voice polyphonics are available for multitracking.

The DS3 includes three disks together with a starter kit of sounds. The manual includes instructions for installation and advanced instructions on sequence building, sound editing at the screen, and external sync techniques.

The DS3, priced at $1200, is available from British Imports Limited, 2410 N. Hathaway, Santa Ana, CA 92701, (714) 542-9178.
Circle 775 on inquiry card.

Speech Synthesizer and Software

SynPhonix 100 for the Apple II, IIe, and II+ is a speech synthesizer board with the SSI263 phoneme chip. It plugs into slots 1 through 7 and includes an amplifier, volume control, and a jack for an external speaker. It can also be purchased with an on-board speaker. The board has a socket for a second voice, but the second voice is not available yet.

Sonix-65, a speech operating system on disk, comes with it. SynPhonix 100 costs $125 or $135 with the on-board speaker. Contact Artic Technologies, 2234 Star Court, Auburn Heights, MI 48057, (313) 852-8344.
Circle 784 on inquiry card.

Social Programs

A series of young people's programs on social and personal health issues is available from Marshware for the Apple computer. The programs include software about good health, teenage drinking, reasoning skills and sexual abuse awareness. Biology programs on the respiratory system, the digestive system, bones and muscles, and the heart are available for $39.95 each.

Programs entitled Alcohol and Keeping Safe are available for $49.95 each.

Write Marshware, POB 8082, Shawnee Mission, KS 66208, (800) 821-3303.
Circle 778 on inquiry card.

Disk-Head Accessory

The Disk Drive Analyzer for the Apple II series and the Apple III checks the alignment of the heads, their speed, and how well they clamp disks—conditions that affect accuracy. It costs $39.95.

The same company makes the Diskette Head Cleaning Kit for the Macintosh. It comes with a software tutorial, two cleaning disks, and a spray cleanser. The kit costs $39.95. The software by itself costs $29.99.

Contact Nortronics Computer Inc., Recorder Care Division, 8101 Tenth Ave. N., Minneapolis, MN 55427, (612) 545-0401.
Circle 781 on inquiry card.

Template Summaries

Kleertex templates summarize Apple software commands for several popular programs. They fit over Apple keyboards to provide "at-a-glance" help to users looking for the right command.

The templates are made of durable molded plastic, color-coordinated to each personal computer.

Kleertex templates cost $19.95 each. They are made and sold by Creative Computer Products, POB 85152-MB134, San Diego, CA 92138. The firm takes orders over toll-free lines: 1-800-231-5413 or, for California residents, 1-800-523-5441.
Circle 780 on inquiry card.

Five-inch Screen for the IIc

The XVU 5-inch screen for the Apple IIc makes the computer even more portable.

This is the same screen that is used for the XCalibur Portable; it weighs 2.2 pounds or 1 kilogram. A single plug connects the video and power. For more information, contact XCalibur Computers Ltd., Spencer House, 3 Spencer Parade, Northampton, England NN1 5AB or call (0604) 21051/4.
Circle 782 on inquiry card.

(continued)



The 5-inch XVU for the IIc.

Modem and Software

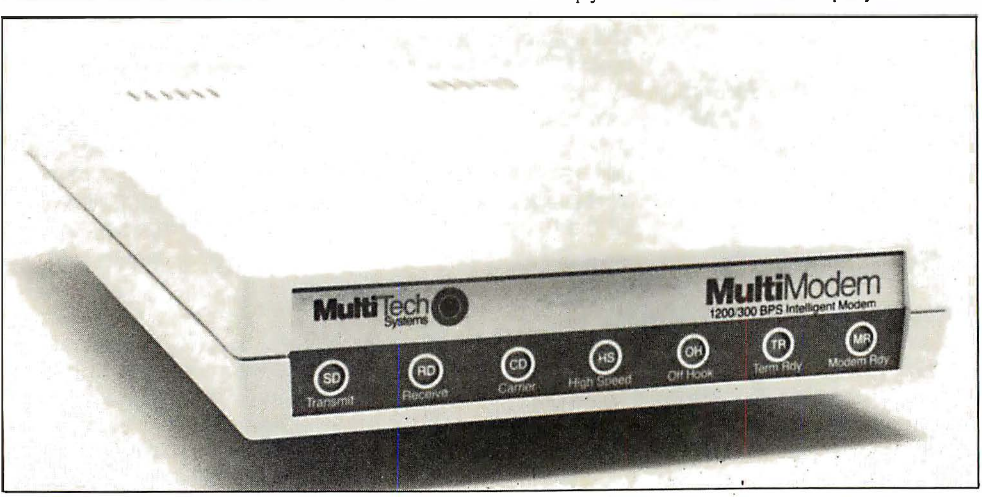
The single-board, 300/110-bps MultiModem IIe automatically answers and dials telephone calls. The board and software for the Apple II, II+, and IIe work with push-button and rotary-dial telephones. The product is compatible with the Hayes MicroModem II and, therefore, with nearly all communications software written for Apple II computers.

MultiModem's menu-driven firmware allows the user to leave an application program and enter the on-line communications mode with a single keystroke.

The MultiCom II software included with the modem lets users automatically log on to networks and copy data to screen or disk. Free time from CompuServe and NewsNet comes with the package.

The $329 price includes a two-year warranty. MultiModem IIe is made by Multi-Tech Systems Inc., 82 Second Ave. SE, New Brighton, MN 55112, (612) 631-3550.

Circle 793 on inquiry card.



New single-board modem from Multi-Tech Systems features auto-dial.

Three from Penguin

Graphics Magician Picture Painter uses less memory than most graphics programs because it stores the directions to redraw pictures rather than the pictures. The program can now be used with double-high-resolution Apples. You can use a joystick, mouse, touch tablet, the Apple Graphics Tablet, or Houston Instruments' HiPad to draw or color. The program lets you use 16 solid colors or 256 blends. It costs $49.95 from Penguin Software.

Expedition Amazon is a new fantasy game. The player leads an expedition of four specialists into the Amazon rain forest to find the ruins of a fabled Inca stronghold that harbors a great secret. The game has dozens of high-resolution graphics and nine levels of difficulty. Its complexities take up both sides of a 48K-byte disk. Expedition Amazon costs $34.95.

Penguin Software is also selling a new Disk arRanger for the 48K-byte Apple II, IIe, and II+. It lets you arrange disks alphabetically or by topic. You can label them by using control characters or graphics signals such as flashing. If you have 64K bytes of RAM, the program also lets you move files from disk to disk quickly. It costs $29.95.

Contact Penguin Software, POB 311, Geneva, IL 60134, (312) 232-1984.

Circle 786 on inquiry card.

Alternative Keyboard

Sure-Stroke is an alternative keyboard similar to the IBM Selectric typewriter keyboard. Function keys run across the top, and it has a separate numeric keypad. Sure-Stroke costs $199.95 and comes with a one-year warranty. Contact Titan Data Systems Inc., POB 2095, Santa Ana, CA 92707, (714) 546-6467.

Circle 783 on inquiry card.

Print Your Graphics from a IIc

Printographer, a program that allows you to print or save graphics, can now be used with the Apple IIc. It is compatible with more than 50 printers, prints low- or high-resolution graphics, and prints in color or black and white.

In can magnify pictures or parts of pictures and print negative black-and-white images. Printographer is also available through Apple dealers for the Apple II, IIe, and II+.

Combined with The Write Choice, the manufacturer's word processor, Printographer can print text with pictures.

Printographer costs $39.95, from Roger Wagner Publishing, POB 582, Santee, CA 92071, (619) 562-3670.

Circle 788 on inquiry card.

Technical Design Kit for the Professional

Cad-2 firmware for the Apple II+ and IIe does technical drafting and designing by combining joystick drawing and measurements entered from the keyboard. The user can see dimensions changing and shapes rotating on the screen.

Cad-2 lets you enter line lengths, angles, arc radii, and arch sweeps from the keyboard to do scaled drawings in English or metric measures.

The Cad-2 package includes the software, the joystick, a 128K-byte RAM board that fits into an I/O slot on the motherboard, a library disk, and detailed instructions and explanations of the system. No knowledge of computers is necessary to use Cad-2.

It costs $1790. Cad-1 can be upgraded to Cad-2 for $695. Cad-1 and 2 are made by Robo Systems of Chessell-Robocom Corporation, 111 Pheasant Run, Newtown, PA 18940, (215) 968-4422.

Circle 792 on inquiry card.

(continued)

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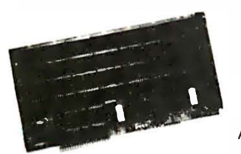
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Circle 662 on inquiry card.

Drawings and Data Files Linked

Filevision for the Macintosh links drawings with data files.

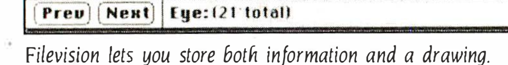
The program allows you to draw directly on the Mac screen with a mouse label, highlight sections of the drawing, and store both the text and the drawing on a disk.

Filevision is mouse-driven. You can even select certain information to be highlighted when your drawing and text are printed.

An editor allows you to create your own symbols in addition to the 20 supplied with the Filevision palette.

Filevision costs $195. Write Telos Corp., 3420 Ocean Park Blvd., Santa Monica, CA 90405.

Circle **785** on inquiry card.



Filevision lets you store both information and a drawing.

Digital Images on Your Apple

Computereyes for 48K-byte Apple II computers transposes video images to Apple's high-resolution display. It connects to the Apple's game I/O port and to video cameras, disks, or recorders. Pictures appear on the screen within 5 seconds and can be saved on disk. Computereyes software is not copy-protected and will run on any 48K-byte Apple that has Applesoft and DOS 3.3.

The package costs $129.95 or $349.95 with a video camera. It comes with a one-year warranty. Contact Digital Vision Inc., 14 Oak St., Suite 2, Needham, MA 02192, (617) 444-9040.

Circle **779** on inquiry card.

Waterproof Bag

The PC-3004 Macintosh Bag is custom-designed luggage made from a material called Cellular Armor, which is waterproof and flexible. It can be purchased with a zip-on section for the keyboard and modem and printer. With the zip-on compartment, it costs $199.95. Without it, it costs $129.95. Contact Kiwi, 6721 NW 36th Ave., Miami, FL 33174, (305) 835-8228.

Circle **790** on inquiry card.

Repair Kit

Apple Patch for the Apple II and II+ is a hardware repair kit. It includes a chip puller, duplicates of all the Apple II chips except ROMs, and a detailed manual, especially written for the amateur repairperson.

Apple Patch costs $89.95. It is made by Ivie Computer Corp., 460 N. University Ave., Suite 204, Provo, UT 84601, (801) 373-1313.

Circle **794** on inquiry card.

Apple Music Board

PC to Mac and Back is a communications package that allows a Macintosh and an IBM PC to communicate.

The package, complete with a book and two disks, enables a Macintosh or IBM PC to communicate with almost any other computer equipped with an RS-232C serial port and its own communications software. The package transfers both text and binary files.

PC to Mac and Back allows direct communication using a null modem or the phones.

The product sells for less than $100 from Dilithium Press, Suite 151, 8285 SW Nimbus, Beaverton, OR 97005, (800) 547-1842, in Oregon (503) 646-2713.

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Lisa and Mac Programs, Apple II Boards from Videx

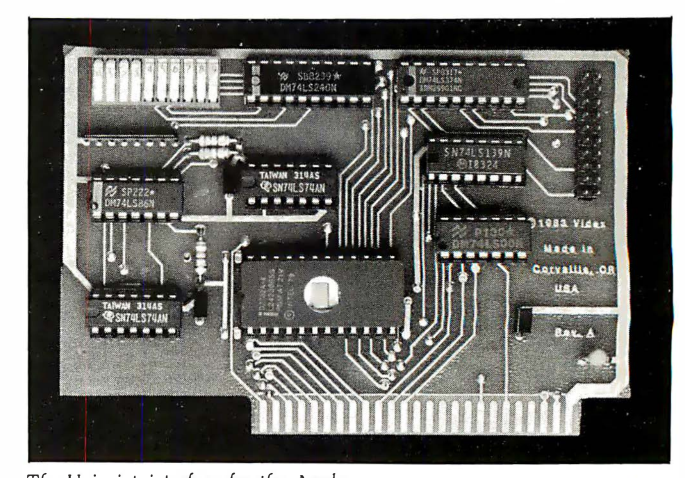
Desktop Calendar for the Lisa 2 and Macintosh is an appointment book and notepad on a calendar display. The calendar's alarm will interrupt other programming to remind you of an appointment. Desktop for the Lisa costs $295 and for the Macintosh costs $89.

Uniprint is an interface for the Apple II and IIe to parallel printers. The documentation includes switch configurations for 25 popular printers and comes with Centronics-compatible cable. The Uniprint transfers high-resolution and double-high-resolution graphics to a printer and shrinks, expands, or rotates (90 degrees) an image. It costs $89.

Ultraterm, an 80-column card for the Apple II, IIe, and II+, can also display 96, 128, 132, or 160 columns across an Apple screen. The firmware and manual costs $379.

All of the above products are available from Videx, 1105 NE Circle Blvd., Corvallis, OR 97330, (503) 758-0521.

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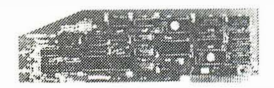
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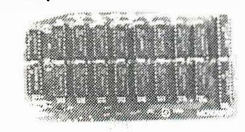
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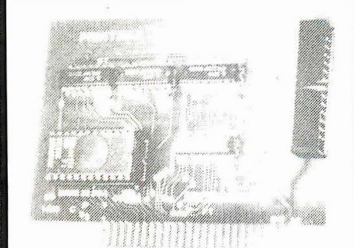
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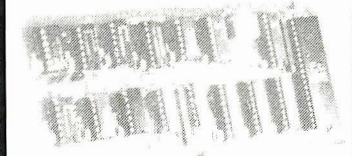
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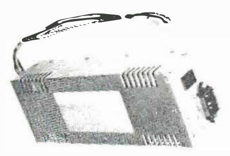
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4	A30	Low-Cost Word Processing on the Apple	Gingras
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9	A67	An Interview with Steve Wozniak	Williams, Moore
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676	698	720	742	764	786	808
677	699	721	743	765	787	809
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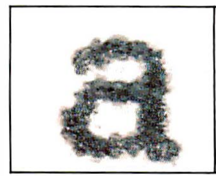
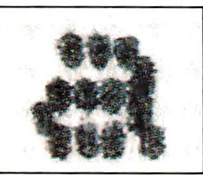
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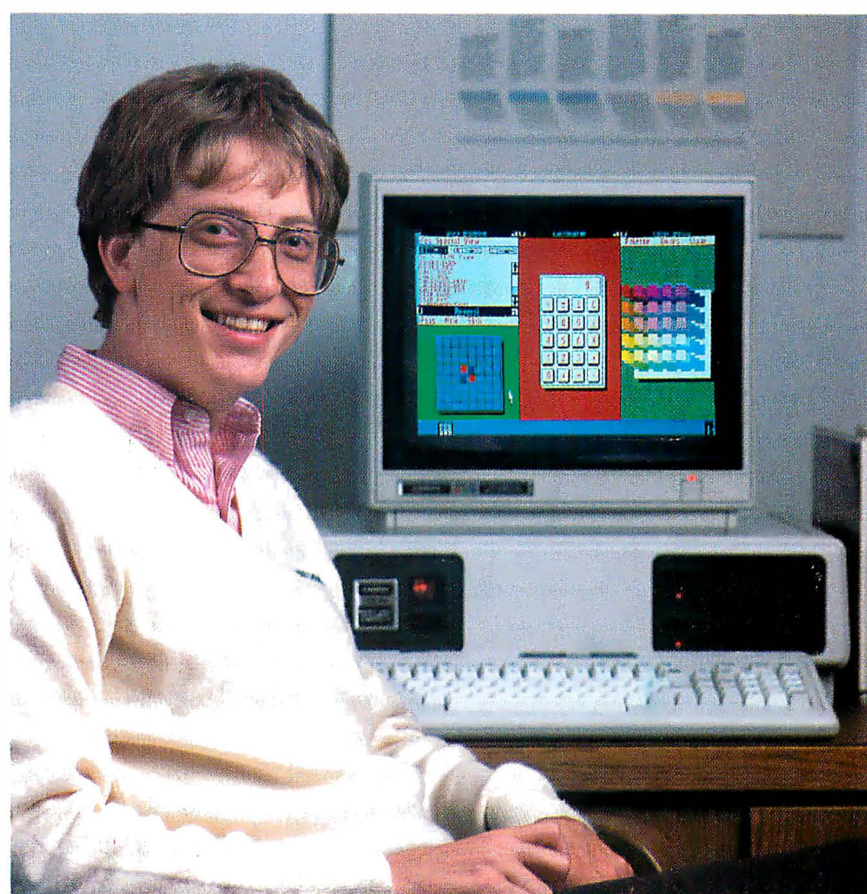
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